Analysis of Coupling Coordination Relationship between New Urbanization Inclusive Development Level and Humanistic Ecological Environment of Jiangxi

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Abstract

Current urbanization construction has changed from the material function oriented pattern to the improving of the living environment, under the premise of continuing to promote the inclusive development of new urbanization, the research focuses on the protection of the humanistic ecology characteristic. By Taking 11 cities in Jiangxi Province as the research object, and adopting the coupling analysis method, a coupling coordination degree model of inclusive development level and humanistic ecological environment was constructed, by calculating the coupling coordination degree of inclusive development level and humanistic ecological environment of 11 prefecture-level cities in Jiangxi Province in 2014, evaluation of the coupling stage and degree of the two was made and classification was carried out according to the coupling coordination degree.

The results showed that the level of the coupling coordination degree of inclusive development level and humanistic ecological environment of 11 prefecture-level cities in Jiangxi Province is good, core cities like Nanchang, Ganzhou City etc. played a leading role in the regional development, but from the provincial level, regional differences existed in the coordinate development level. Humanistic ecological environment is a key factor of the inclusive development of new urbanization, in human based urban construction; attentions must be paid to the harmonious development of man and nature to achieve the coordinate organic unification of new urbanization process and humanistic ecological environment.

Keywords: new urbanization, inclusive development, coupling coordination, humanistic ecological environment.

Introduction

With the development of China's reform and opening up policy, China's economy maintains a long-term rapid growth; at the end of 2014, China's urbanization rate has reached 54.77%. According to the "urbanization process curve" proposed by the American city scholar Northam in 1979, the current urbanization in China is in the second stage of the S curve[1]. However, in the process of rapid urbanization, many problems occurred, such as the excessive concentration of population, the increase of urban load pressure and so on. These problems lead to serious damage of the humanistic ecological environment; therefore, the protection of the ecological environment in the process of urbanization is needed to achieve the coordinated development between the two.

The related researches of foreign scholars mainly focus on the relationship between urban economic development and environmental pollution to explore the relationship between the humanistic ecological environment and inclusive development of new urbanization. American economist Grossman (1991), in the study of environmental economy, confirmed the relationship between environmental quality and per capita income[3] for the first time. Panayotou (1996), by borrowing Kuznets's inverted U type curve, name the curve of the relationship between the quality of the environment and the per capita income as the Kuznets curve[4].

Some scholars studied the relationship between urbanization development and certain resource and environment, Gandy (2004) found that the restriction of water resource limited the urban spatial layout; there was a need to properly handle the relationship of water resources and urbanization development[5]. German scholar Pounmanyvong (2010) carried out an empirical study on the relationship between urbanization and energy consumption and carbon emissions, and found that the rapid advance of urbanization will increase carbon emissions[6]. Huang Jinchuan (2003) argued that there was an interactive coupling stress mechanism between urbanization and humanistic ecological environment, the humanistic ecological environment of urbanization is mainly due to changes of population and capital flow direction[7].

Liu Yaobin (2006) found that the coupling mechanism of urbanization and humanistic ecological environment system is complex, but it mainly manifested on two aspects, namely, humanistic environment the stress effect of urbanization on the humanistic ecological environment, and the constraint function of humanistic ecological environment on urbanization[8]. Chen Xiaohong (2011), took Northeast China as an example, evaluated the harmonious relationship between its urbanization and humanistic ecological environment, and the divided the coordinated relationship into 3 types[9]. Hou Pei, Yang Qingyuan (2014) adopted

empirical analysis in their study, the result showed that the higher the level of economic development is, the higher the degree of coupling between urbanization and humanistic ecological environment will be[10].

Zeng Hao (2012), based on the coupling coordination degree model, concluded that the coordination degree between the urbanization of Wuhan city and humanistic ecological environment in the period of 2000 - 2010 is in moderate disorder for 3 years, is in mild disorder for 5 years, and barely coordinated for another 3 years[11]. Zhang Rongtian, Jiao Huafu (2015), through the construction of the evaluation index system of urbanization and humanistic ecological environment system, adopted PCA model to estimate the comprehensive value of urbanization and humanistic ecological environment system[12]

The humanistic ecological environment takes human as its research object and focuses on humanism; it is an ecological system which is formed by the interaction and mutual influence between humanistic culture and its external environment. Therefore, under the circumstance when Jiangxi actively promoting new urbanization, the study of coupling coordinative relationship of inclusive development and humanistic ecological environment, and the discussion of the mutual influence regularity and coordinated development mechanism are with great theoretical value and practical significance.

Taking 11 prefecture-level cities in Jiangxi Province as the research object, this paper, based on the humanistic ecological environment concept, and synthesized the influencing factors of comprehensive new urbanization system and humanistic ecological environment system, constructed both a comprehensive evaluation index system of the coordinated development between the two. By adopting the variation coefficient method to evaluate the development level and the coupling coordination situation of urbanization and humanistic ecological environment, based on the inclusion of it provided a reference for the promoting of Jiangxi Province's new urbanization and humanistic ecological environment coupling coordinated development.

Research Areas and Research Methods

An Overview of the Research Areas: Jiangxi province, located in the southeast of China, covers an area of 166,900 km2. Its terrain is mainly Jiangnan hills region and mountain land. By the end of 2014, the resident population was 45.422 million people, the province's GDP value was 1.67238 trillion Yuan, the per capita GDP was 34661 Yuan, and the urbanization rate reached 51.6%. There are 11 prefecture-level cities, 22 municipal districts, 67 counties in Jiangxi Province[13].

With the country's support for the development of the central provinces, Jiangxi Province vigorously promote the integration of Nanchang and Jiujiang, and the revitalization of the Soviet Area in Southern Jiangxi and other related development policies, a north and south urban agglomeration, with Nanchang and Ganzhou City as the core cities, has been formed. On the whole, the urban supporting system is gradually improving, the industrial structure is optimizing, but effective development of green environmental protection industry is inadequate, certain high energy consumption industry, such as mineral, iron and steel industry and manufacturing industry, still has a serious impact on humanistic ecological environment.

As shown in Fig 1, the relationship between urbanization rate and water resources application amount of 11 prefecture-level city in Jiangxi Province reflects the interaction between the two, it also reveals that, as part of "the land of fish and rice", Jiangxi Province is rich in water resources, it has a good humanistic ecological environment foundation, and is abundant in non-ferrous metals, precious metals and other mineral resources, therefore, how to reasonably exploit these congenital natural resources, and lower its impact on the environment to minimum become the top priority for the coordination of inclusive development and humanistic ecological environment in new urbanization.

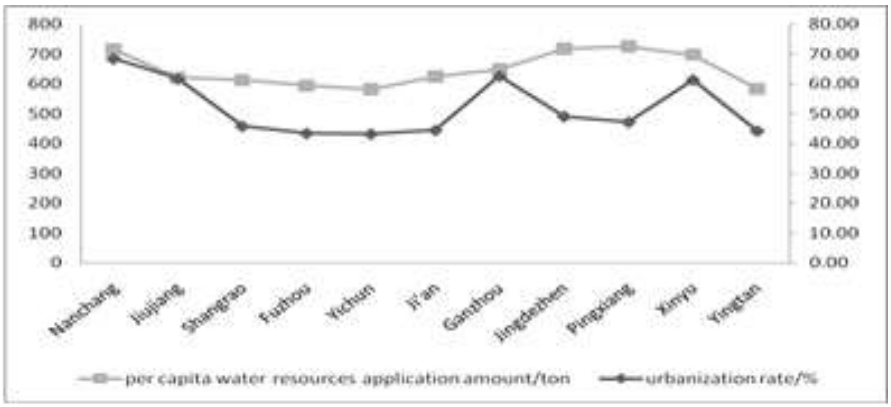

Fig. 1: urbanization rate and per capita water resources application amount of 11 prefecture-level cities in Jiangxi province in 2014

The Construction of Index System: Accurate assessment based on the relationship between inclusive development model and humanistic ecological environment of urbanization, this paper, on the basis of the Xia Feng and other scholars' research results and evaluation system, selected population urbanization, space urbanization, economy urbanization and social urbanization indexes in inclusive development system of new urbanization.

At the same time, in consideration of the complex geographical situation, spatial differences existed in the distribution of humanistic ecological environment, the ecological protection objectives and tasks are different. Thus, in this paper, the humanistic ecological environment system is divided into humanistic ecological environment level, humanistic ecological environment stress and humanistic ecological environment protection indexes[14]. In accordance with the selection principle of science and convenience and according to the actual development of 11 prefecture-level cities in Jiangxi Province, 24 indexes were chosen to build a coordination relationship assessment index system of new urbanization inclusive development level and humanistic ecological environment, as shown in Table 1 below.

Table 1
A coordination relationship assessment index system of new urbanization inclusive development level and humanistic ecological environment

	Criterion layer	Index layer	Weight
New urbanization inclusive development level system u_1	population urbanization (0.2415)	urban population proportion（%）	0.0933
		nonagricultural population proportion（%）	0.0739
		share of employment of tertiary industry（%）	0.0743
	space urbanization（0.1633）	Urban area（km^2）	0.0762
		Urban population density（person/km^2）	0.0871
	economy urbanization（0.2978）	per capita GDP（Yuan）	0.0997
		Proportion of tertiary industry in GDP（%）	0.0989
		per capita disposable income in urban areas（Yuan）	0.0992
	society urbanization（0.2974）	per capita total retail sales of social consumption（ten thousand Yuan /person）	0.0855
		Doctors number per ten thousand people（person/ ten thousand people）	0.0664
		Private cars number per ten thousand people（car/ ten thousand people）	0.0838
		college students number per ten thousand（person/ ten thousand people）	0.0617
humanistic ecological environment system u_3	humanistic ecological environment level（0.3424）	per capita water supply（m^3/person）	0.0893
		electricity consumption per ten thousand GDP（tee/ ten thousand Yuan）	0.0742
		natural gas consumption rate（%）	0.0831
		per capita park greenbelt（m^2/person）	0.0958
	humanistic ecological environment stress（0.3268）	per capita electricity consumption（kilowatt /person）	0.0948

		per capita discharge amount of industrial wastewater t/person）	0.0923
		per capita Solid wastes output （t/person）	0.0754
		per capita discharge amount of industrial waste gas （10000m^3/person）	0.0643
	humanistic ecological environment protection （0.3308）	centralized processing rate of urban wastewater （%）	0.0824
		bio-safety disposal rate of urban garbage （%）	0.0993
		comprehensive utilization ratio of industrial solid wastes （%）	0.0764
		Industrial water reuse rate （%）	0.0727

The original data were collected from the 2014 statistical yearbook of Jiangxi Province, the 2014 national economic and social development statistical bulletin, and panel data from the statistical yearbook of prefecture-level cities[15-16]. The impact of urbanization on the ecological environment as shown in Figure 2

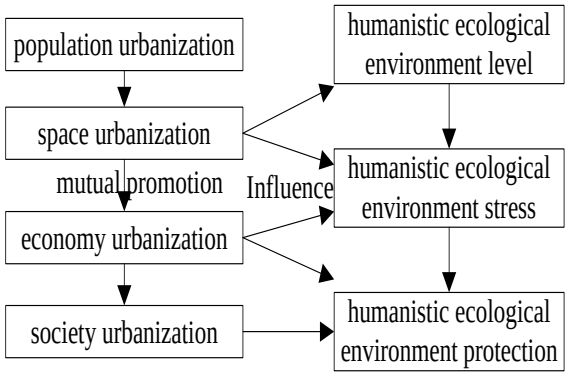

Fig. 2: The impact of urbanization on the ecological environment

Data Processing: Due to the large discrete degree of index data, and non-unified dimension on the part of the index contrast, in order to eliminate the effect of measurement scale and dimension, this paper employed the coefficient of variation to determine the index weight, and took the ratio of standard deviation of the original data and the average number of original data. Using the variation coefficient can make full use of the information provided by the index itself, and can reflect the relative importance of the index, the formula is as follows.

$$V_i = \frac{\sigma_i}{x_i}, (i = 1, 2, \cdots, n) \quad (1)$$

Among them, V_i is the coefficient variation of the i index, σ_i is the standard deviation of the i index, $\overline{x_i}$ the average of the i index. As a result, the weight of each index can be determined as:

$$\omega_i = V_i / \sum_{i=1}^{n} V_i, (i = 1, 2, \cdots, n) \quad (2)$$

The established index system in Table 1 shows that some of the humanistic ecological environment indexes are with positive and negative direction, in order to facilitate the comparison, first of all, before determining the weight of every index, the maximum difference normalization method was employed to the normalization of the original data, then the coefficient variation of the index can be calculated, the formula is as follows.

$$X_i' = \begin{cases} (x_i - \min x_i) / (\max x_i - \min x_i) \\ (\max x_i - x_i) / (\max x_i - \min x_i) \end{cases} \quad (2)$$

Among them, the above formula is for the positive and negative indexes, x_i is the original index value, $\min x_i, \min x_2$ respectively, indicating the minimum and maximum of the original index.

Coupling Scheduling Model: Coupling refers to the phenomenon which caused by the interaction and mutual influence of two or more than two systems or motion pattern exercise, the coupling degree refers to the degree of the systems or elements that influence each other, multiple systems or elements interaction coupling degree model can be obtained.

$$C_n = \left\{ (u_1 \times u_2 \times u_3 \cdots u_i) / [\prod u_1 + u_2] \right\}^{1/n} \quad (4)$$

Among them, u_i represents the comprehensive development level of each subsystem, that is, the comprehensive development level of the new urbanization inclusive development level system and the humanistic ecological environment system. From the formula we can know, $C \in [0,1]$, the more the C is closer to 1, the stronger the coupling degree of the system will be, otherwise, it will be weaker. When $C = 1$, the correlation between coupling degree and maximum surface system reached its maximum, when $C = 0$, coupling degree is minimum, indicating that the

systems are unrelated to each other, and not affect each other.

However, the coupling degree inclined to reflect the similarity of the system elements, it cannot reflect the overall development level of elements and their synergistic effects well, and it is not in accordance with the contents of the study, therefore, it is necessary to employ the coupling coordination degree to indicate the coordinative relationship between new urbanization inclusive development level and humanistic ecological environment[17], Fig 3 shows the coupling coordinative relationship between humanistic ecological environment and urbanization.

$$D = (C \cdot T)^{1/2}, T = \alpha u_1 + \beta u_2 \quad (5)$$

Among them, D is coupling coordination degree, T reflects the comprehensive coordination index of new urbanization inclusive development level and humanistic ecological environment, α and β are coefficients to be determined, indicating the new urbanization inclusive development and humanistic environment impact on the city. Taking into account the two have played a positive role in promoting the development of the city, for the convenience of calculation, take $\alpha = \beta = 0.5$, and comprehensive coordination index $T \in (0,1)$.

According to the coupling coordination degree, the size of the new urbanization inclusive development level subsystem and the humanistic ecological environment subsystem, it can be divided into 5 types. When $0.8 < D \le 1$, it is good coordination, when $0.6 < D \le 0.8$, it is high coordination, when $0.4 < D \le 0.6$, it is moderate coordination, when $0.2 < D \le 0.4$, it is low coordination, when $0 < D \le 0.2$, it is seriously imbalance coordination. And each type can be divided into several sub categories according to the new urbanization inclusive development level subsystem $u_1(x)$ and humanistic ecological environment subsystem $u_2(x)$, when $0.8 < D \le 1$, $u_1(x) - u_2(x) > 0.1$, it is highly coordinated humanistic ecological environment lag type; when $u_2(x) - u_2(x) > 0.1$, it is highly coordinated urbanization lag type, when $|u_1(x) - u_2(x)| < 0.1$, it is coordinate balance type[18].

Coupling Coordination Relationship Analysis

New Urbanization Inclusive Development Level and the Comprehensive Index of Humanistic Ecological Environment: Analysis of the new town of inclusive development subsystem level reveals that, economy urbanization has the biggest influence on the new urbanization inclusive development level, its weights is 0.2978. The effect of population urbanization, space urbanization is relatively small; this mainly is due to the implementation of the national family planning policy which greatly slowed down the population growth, in 2014, the population of Jiangxi Province has an increase of 0.4%, lower than the national level.

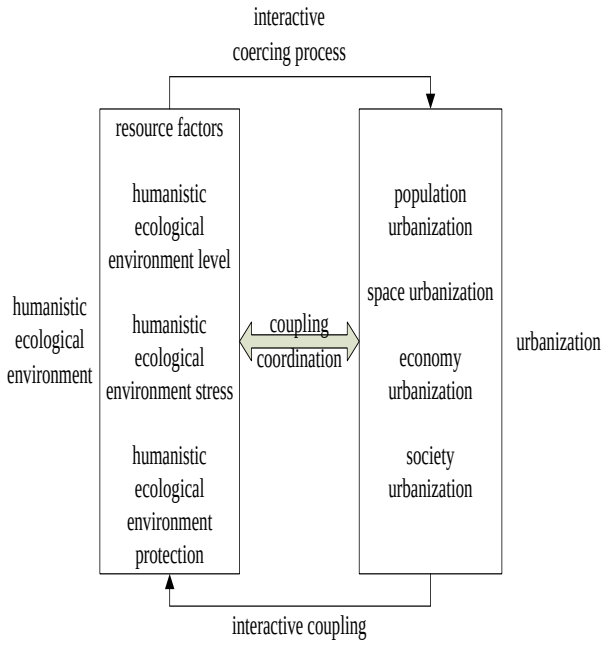

Fig. 3: coupling relationship between urbanization and human environment

And the development of modern agriculture, green industry upgrading, the tertiary industry and other economic factors became the main factor in promoting the development of new urbanization inclusive development. At the same time, we can see social urbanization accounts for a large proportion, up to 0.2974, indicating that the key of inclusive development lies in the improvement of the social security system, only provide comprehensive social service, and earnestly safeguard the vital interests of urban residents is the effective representation of the people-oriented concept of inclusive development.

Index weight distribution of humanistic ecological environment subsystem shows that the humanistic ecological environment level and humanistic ecological environment stress have a great influence to the comprehensive level of humanistic ecological environment of Jiangxi Province; this indicates that the influence of humanistic ecological environment is still dominated by stress; humanistic ecological environment protection needs to be further strengthened. In the process of new urbanization development, humanistic ecological environment stress is still very large, and it is not desirable to obtain the development of new urbanization at the expense of sacrificing human ecological environment.

Selected original data of 24 indexes of new urbanization inclusive development level and the comprehensive index of humanistic ecological environment of 11 prefecture-level cities in Jiangxi province in 2014, after standard treatment of the original data, based on the weights of the evaluation

indexes of all subsystems, this paper will calculate the comprehensive score of new urbanization inclusive development level and the comprehensive index of humanistic ecological environment of all the prefecture-level cities in 2014 by using linear weighted method. The new town of inclusive development level and the humanities ecological environment system and on the basis of this calculation, the indexes of new urbanization inclusive development level and the comprehensive index of humanistic ecological environment will be calculated. Results are shown in table 2.

Coupling Coordination Degree Analysis: According to the calculation of the comprehensive index in Table 2 and the coupling coordination degree of prefecture-level cities, the regional differences between different cities were explored and the calculation results are as shown in figure 4.

Table 2
The indexes of new urbanization inclusive development level and the comprehensive index of humanistic ecological environment of 11 prefecture-level cities in Jiangxi province

S.N.	City	Index of new urbanization inclusive development level	Index of humanistic ecological environment	Coupling coordination degree
1	Nanchang	0.9012	0.5572	0.8132
2	Jiujiang	0.8729	0.5798	0.8043
3	Shangrao	0.6421	0.5534	0.5429
4	Fuzhou	0.5923	0.6213	0.3978
5	Yichun	0.4437	0.4519	0.4976
6	Ji'an	0.3262	0.6874	0.5819
7	Ganzhou	0.8831	0.7458	0.8413
8	Jingdezhen	0.4197	0.4357	0.6438
9	Pingxiang	0.3345	0.5439	0.5979
10	Xinyu	0.5476	0.6981	0.6124
11	Yingtan	0.2417	0.7235	0.3826

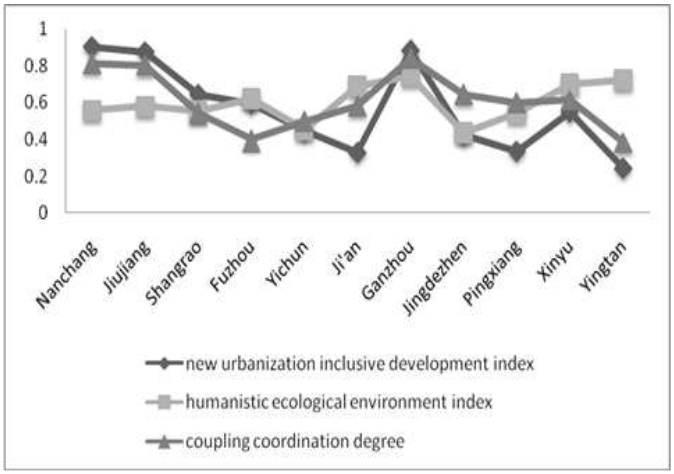

Figure 4: New urbanization inclusive development level and the humanistic ecological environment coupling coordination of 11 prefecture-level cities in Jiangxi province

From the data in table 2 and the trend in figure 4 can be seen that, in Jiangxi Province, the new urbanization inclusive development has reached at a certain level, but the region difference is relatively obvious, Nanchang, as the economic and political center of the province, topped the development level list of the province; Ganzhou is rich in mineral resources, it developed new industries on the basis of resources, and a higher level of social security has also contributed to the inclusive development of new urbanization in Ganzhou city. At the same time, humanistic ecological environment comprehensive index also showed significant regional differences, Jiujiang, Ganzhou, Yichun have good ecological environment foundation and are abundant in natural resources, the humanistic ecological environment index in these areas are relatively large, while some cities, humanistic ecological environment was destructed due to industrial development, such as Nanchang, Jingdezhen, and other prefecture-level cities, although they has taken many environmental improvement measures in recent years, but the comprehensive index of humanistic ecological environment is still low.

Take the coupling coordination degree of the new urbanization inclusive development level and the humanistic ecological environment comprehensive index as the attribute data, and then employ the ArcGIS10.2 software to get the coupling coordination degree. As can be seen from Figure 5, the new urbanization inclusive development level and the overall situation of humanistic ecological environment comprehensive index is relatively, it showed a trend of improvement. According to the spatial distribution, we can know, new urbanization inclusive development level and the comprehensive index of humanistic ecological environment of 11 prefecture-level cities in Jiangxi province has obvious spatial differentiation characteristics, it presents a strong regional massive agglomeration characteristics. It mainly manifested in the north and south city circle with Nanchang and Ganzhou as the core, Nanchang, Jiujiang, Ganzhou are

the first segment of the coupling coordination ladder which represents the highly coordinated region.

While Yingtan, Fuzhou and Shangrao and other cities showed relatively low the coupling coordination degree, they vary between moderate coordination and low coordination. Notice that most area of Jiangxi Province is above moderate coordination, which also shows the new urbanization inclusive development of Jiangxi Province is good, and it takes humanistic ecological environment carrying capacity into account, the urbanization is no longer based on the destruction of the humanistic ecological environment.

Coupling Category Analysis: Based on the above calculated new urbanization inclusive development level and humanistic ecological environment comprehensive index to calculate and the difference value between $u_1(x)$ and $u_2(x)$, and then determine the inclusive development level and humanistic ecological environment coupling coordination degree types. Results are shown in Table 3 below.

According to the obtained results in table 3, inclusive development level and humanistic ecological environment coupling coordination degree types of 11 prefecture-level cities in Jiangxi province contains five types, including good coordination- humanistic ecological environment lag type and so on.

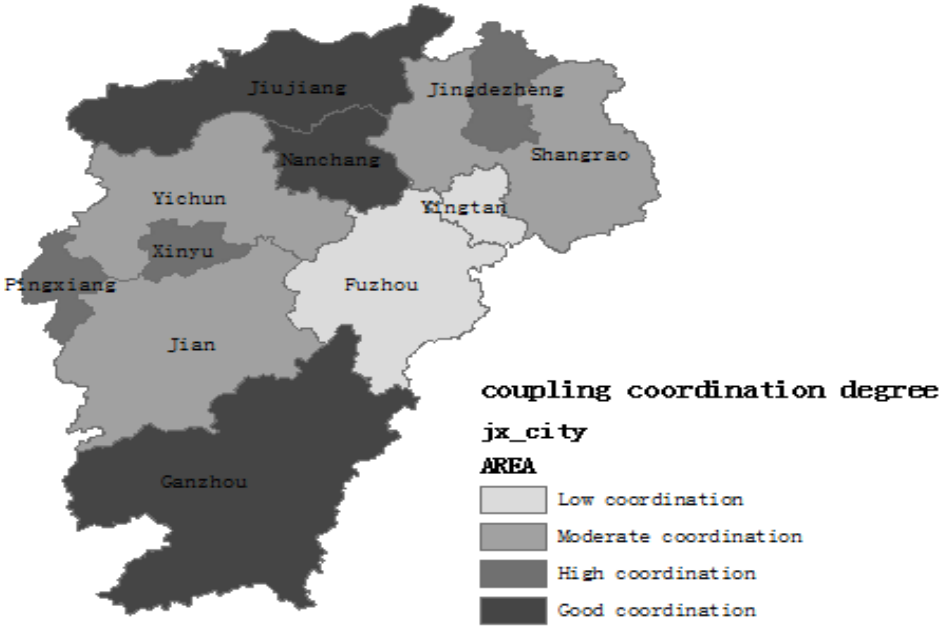

Figure 5: Spatial variation characteristics of the coupling coordination degree of new urbanization inclusive development level and humanistic ecological environment of 11 prefecture-level cities in Jiangxi province

Table 3
Coupling types of 11 prefecture-level cities in Jiangxi province

S.N.	Cities	$u_1(x)-u_2(x)$	Coupling type
1	Nanchang	0.3440	good coordination-humanistic ecological environment lag type
2	Jiujiang	0.2931	good coordination-humanistic ecological environment lag type
3	Shangrao	0.0887	balanced coordination
4	Fuzhou	-0.0290	balanced coordination
5	Yichun	-0.0082	balanced coordination
6	Ji'an	-0.3612	moderate coordination - urbanization lag type
7	Ganzhou	0.1373	good coordination-humanistic ecological environment lag type
8	Jingdezhen	-0.0160	balanced coordination
9	Pingxiang	-0.2094	high coordination- urbanization lag type
10	Xinyu	-0.1505	high coordination- urbanization lag type
11	Yingtan	-0.4818	low coordination - urbanization lag type

Good coordination-humanistic ecological environment lag type includes three cities, namely, Nanchang, Jiujiang and Ganzhou, these cities make full use of their own advantages to promote the new urbanization development. And the new urbanization inclusive development level index was significantly greater than the humanistic ecological environment index, which shows that the development of new urbanization did not keep pace with the humanistic ecological environment.

High coordination - urbanization lag type includes Pingxiang and Xinyu, from the new urbanization inclusive development level and the humanistic ecological environment comprehensive index, it is to conclude that new urbanization inclusive development level of Pingxiang and Xinyu is not high, but they effetely used the their advantages to promote urbanization development, and the coupling coordination between it and humanistic ecological environment is good.

Moderate coordination - urbanization lag type only includes Ji'an City, from the n comprehensive index of humanistic ecological environment, we can see that the urbanization level in Ji'an city is low; it is only higher than that of Yingtan City, indicating that Ji'an has great new urbanization inclusive development potential.

Low coordination - urbanization lag type includes Yingtan City, the new urbanization inclusive development level of Yingtan was the lowest in the province. There is a big gap between it and the high level areas of the province; this requires Yingtan to improve its new urbanization inclusive development level.

The balance coordination indicates that the difference value between new urbanization inclusive development level and the comprehensive index of the human ecological environment of the region is in a permitted range, that is, the region is in a state of relative balance. Balance coordination includes four prefecture-level cities, namely, Shangrao, Fuzhou, Yichun, Jingdezhen, new urbanization inclusive development level and the humanistic ecological environment comprehensive index the four cities of were roughly ranked in the middle of the province level.

Conclusion

based on the basic concept of humanistic ecology, constructed the new urbanization inclusive development level and humanistic ecological environment coupling coordination degree model, collected the original data 11 prefecture-level cities in Jiangxi province to analyze coupling coordination degree of new urbanization inclusive development level and the humanistic ecological environment, the main conclusions of this research are as follows:

First of all, there are regional differences in the coupling coordination between new urbanization inclusive development level and humanistic ecological environment of the prefecture-level cities in Jiangxi Province, the level of new urbanization and the harmonious relationship between human and ecological environment. The coupling coordination degree of Nanchang, Jiujiang, Ganzhou are the highest, the coupling coordination degree of Xinyu.

Then, quick new urbanization in these areas lead to increased pressure on urban ecological and humanistic environment, excessive concentration of population, and resources and space constraints, which make the humanistic ecological environment lag far behind the new urbanization inclusive development level, this will be a serious challenge in the sustainable development of urbanization.

Finally, the coupling coordination between new urbanization inclusive development level and humanistic ecological environment of the prefecture-level cities in Jiangxi Province overall shows a rising trend. These two city circles need to further exert the leading effect to drive the development of surrounding cities, at the same time, the two cities should uphold the people-oriented inclusive development concept and continuous to improve new urbanization inclusive development level under the premise of guarantying the favorable humanistic environment.

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