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A Study on the Allocation of New Construction Land Use Indicators in Huai'an City

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Abstract This paper makes a comprehensive analysis on the characteristics and influencing factors of regional allocation of new construction land use indicators, and determines the primary indicators from social, economic, external and internal factors. Using Delphi method and correlation analysis, this paper selects indicators and establishes evaluation indicator system. Using entropy method and AHP, this paper determines the weight of indicators, rationally allocates new construction land, and uses the actual data in Huai'an City for case studies, so as to provide a reference for land use planning. In addition, this paper makes a comparative analysis on the land use internal factors as important factors, in order to make the weight assigning more in line with the actual situation of construction land in Huai'an.

Key words New construction land use indicators, Allocation, Land use internal factors, Comparative analysis

1 Introduction

Currently, the serious shortage of new construction land has restricted economic development in some areas, but some local governments rely on low-cost supply to attract investment so as to stimulate local economic growth and enhance administrative achievement[1]. The pursuit prompts some areas to strive for new construction land as much as possible, but they do not efficiently use it in the long run. The allocation of new construction land use indicators in China involves five levels, and municipal level plays a connecting role, so this paper studies the allocation of new construction land indicators at municipal level. In terms of reasonable allocation of construction land, Hong Jianguo *et al.* use a three-scale method to construct the judgment matrix and employ minimum relative entropy principle for allocation[2]. Liao Heping develops a mathematical model to achieve optimal allocation[3]. Yu Yanhua uses the factor method to measure the weight for indicator allocation[4]. In terms of methodology for allocation of construction land use indicators, the main methods include comparative analysis[5], entropy analysis[2, 6], principal component analysis[5] and factor method[4], and the most commonly used method is AHP[2, 6 – 8]. Therefore, based on the problems in the use of new construction land at municipal level, this paper creatively considers the influence of land use internal factors, uses entropy analysis and AHP to determine the weight of evaluation indicator system constituted by the selected influencing factors, and determine the regional weight according to the regional indicator value.

2 Evaluation indicator system and allocation methods

2.1 Primary indicators In accordance with the indicator allocation ideas in land use plan, there is a need to consider the revitalization of stock land, economical and intensive use of land, resources and environment carrying capacity, and other factors, so as to promote coordinated regional development and improve the land use level[9]. First of all, we select the primary indicators that affect the allocation of new construction land indicators. The rapid development of urban construction land is affected by a variety of factors such as natural environment, socio-economic conditions and policies[10], so this paper does a comprehensive analysis from social driving factors, economic driving factors, external factors and internal factors of land use that affect construction land, to form the primary evaluation indicator system, involving 39 primary indicators. Social driving factors consist of demographic situation, urbanization rate, people's living conditions and traffic levels; economic driving factors are constituted by the factors that reflect economic benefit, construction investment, financial level and industrialization situation; the policies related to land use as well as the industry development situation are external factors, and currently, there is no reasonable value assigning method for land use policies, so this paper combines the policies with situation for assignment, and the external factors are constituted by policy and situation, location and land status, major projects and economical and intensive level; the internal factors of land use reflect the land use situation, and we select demand forecasting and new reserve that reflect new construction land supply and demand, as well as stock revitalization and land supply rate that reflect construction land use status. The new construction land are converted from agricultural land and unused land, so the new land reserve is defined as the total amount of agricultural land and unused land in the region.

2.2 Selection of evaluation indicators

2.2.1 Selection based on Delphi method. Through the questionnaire survey, the opinions on the importance of primary factors are sought from experts. The questionnaire survey is based on Likert scale, and Cronbach's reliability coefficient analysis is conducted after collecting questionnaires. After the reliability test, the

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screening is completed according to the importance evaluation by experts, and the factors with small average score of importance are deleted, to form the evaluation indicator system A_1.

2.2.2 Selection based on correlation analysis. There is an interaction between construction land change and socio-economic factors, so correlation analysis is often used for analysis of the variation about them. According to the results of the analysis, we eliminate the factors having a low correlation with construction land to form the evaluation indicator system A_2. At the same time, in order to make the factors independent of each other, we do autocorrelation analysis on various factors in the group. On the basis of A_2, we eliminate the factors with a high degree of autocorrelation and low importance, to form the evaluation indicator system A_2 (Fig. 1).

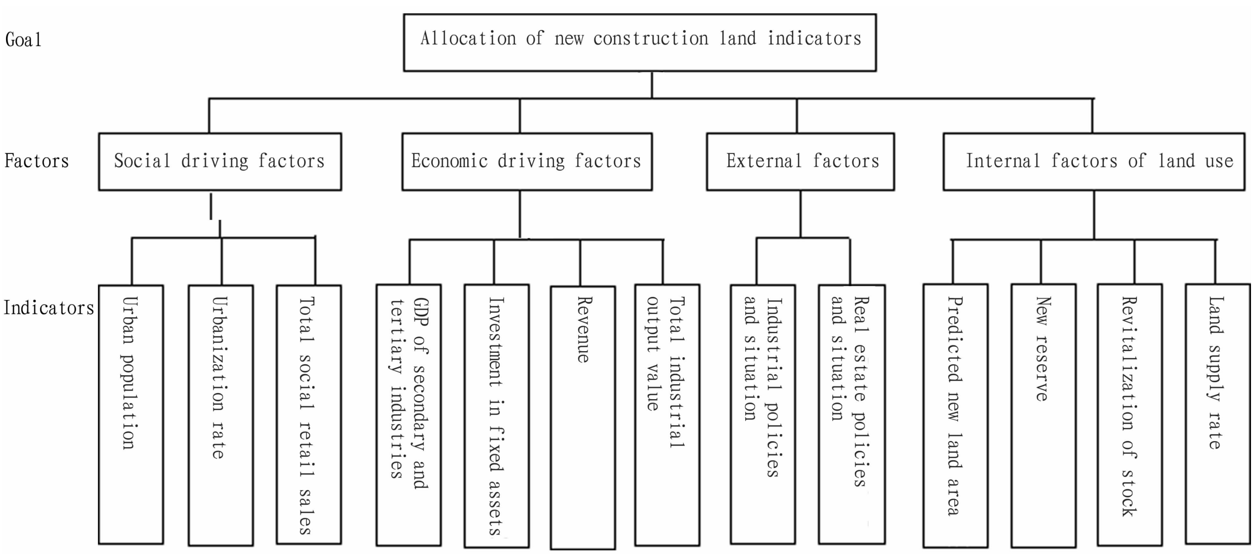

Fig. 1 Indicator evaluation system

2.2.3 Indicator allocation methods for new construction land. Through the actual data calculation of Huai'an, the weight allocation in some areas is not in line with the actual situation. The Analytic Hierarchy Process (AHP) takes into account the experts' knowledge and decision-maker's preference, and the result is often reasonable. Therefore, this paper combines entropy analysis with AHP for indicator allocation for new construction land, in order to improve the credibility and rationality of the results.

(i) Determining objective weight by entropy method. The smaller the information entropy of indicator, the greater the amount of information provided by the indicator, the greater the role in the comprehensive evaluation, the higher the weight. Based on information entropy formula (1) and weight formula (3), the objective weight (r_j) of indicators is calculated.

$$E_j = -\sum_{i=1}^{m} p\ln p\,(j=1,2,\cdots\cdots,n) \quad (1)$$

where $p_{ij} = r_{ij}/\sum_{i=1}^{m}(j=1,2,\cdots\cdots,n)$, r_{ij} is the actual value of indicator j in region i.

$$\text{Let } e_j = \frac{1}{\ln m}E_j\,(j=1,2,\cdots\cdots,n) \quad (2)$$

The objective weight of indicator j:

$$r_j = (1-e_j)/\sum_{j=1}^{n}(1-e_j)\,(j=1,2,\cdots\cdots,n) \quad (3)$$

(ii) Determining the subjective weight by AHP. The experts make group decisions to determine the judgment matrix, conduct consistency test on the judgment matrix, solve the matrix and determine the subjective weight (s_j) after meeting the consistency test.

(iii) Determining the comprehensive weight. In this paper, we use the entropy weight method and AHP to complement each other. Equation (4) is used to calculate the comprehensive weight (w_j).

$$w_j = r_j s_j/\sum_{j=1}^{n} r_j s_j\,(j=1,2,\cdots\cdots,n) \quad (4)$$

(iv) Determining the allocated weight for new construction land indicators. We normalize the regional actual data about the indicators of evaluation index system A_3, and calculate the weight allocated to each region according to the comprehensive weight of indicators.

3 Case study

3.1 Evaluation indicator data acquisition or assignment

We use the standardized land use data during 2008 – 2015 for analysis of 9 counties in Huai'an City. The new land area is predicted by combination forecasting method. As for policies and situation, industry and real estate-related industries are selected according to the proportion of industry for assignment, respectively. The values of industrial policy situation and real estate policy situation are determined by the experts who judge the overall regional policy situation and determine whether the current policy and situation are conducive to the late development. The financial analysis indicators of Peter Lynch: the greater the share of a product in the total sales, the greater the impact on business profit. We learn that the greater the share of one industry in the regional GDP, the greater the impact of policy and situation of the industry on the regional construction land demand. According to the share of overall industrial and real estate GDP in the region, five affected areas are designated. When the overall policy and situation of real estate are good, it will better promote the development of real estate compared with the previous period. If the proportion of real estate GDP in an area is similar to regional overall proportion, then the impact of the current policy and situation is similar to overall impact; if the proportion of real estate GDP in an area is greater than regional overall proportion, then the role of the policy and situation in promoting the development of real estate is greater than the overall role, and the larger the proportion, the greater the role. According to this idea, the assignment method is used to quantify the policy and situation.

3.2 Calculation of the weight allocated to the region According to the initial value of evaluation indicators, we use Equation (5) for dimensionless processing to get the normalized value:

$$H_{ij} = Q_{ij}/Q_{j\max} \tag{5}$$

where H_{ij} is the normalized value of factor j in region i; Q_{ij} is the initial value; $Q_{j\max}$ is the maximum value.

According to the normalized value of evaluation indicator system, we use the above weight calculation method to calculate the comprehensive weight W_t after the judgment matrix meets the consistency requirements. Based on the comprehensive weight (W_t) of indicators and the normalized value (H_{ij}), we calculate the initial weight vector (m_i).

$$m_i = H_{ij} \cdot W_t \tag{6}$$

After the initial weight vector (m_i) is normalized, we get the weight vector (M_i) allocated for new construction land indicators. Table 1 shows the allocated weight for new construction land in different regions.

Table 1 Weight allocated for new construction land

Regions	Qinghe District	Qingpu District	Development Zone	Huai'an District	Huaiyin District	Lianshui County	Hongze County	Xuyi County	Jinhu County
Weight allocated	0.026	0.050	0.124	0.115	0.117	0.124	0.152	0.143	0.148

Table 2 Weight summary

Weight	Qinghe District	Qingpu District	Development Zone	Huai'an District	Huaiyin District	Lianshui County	Hongze County	Xuyi County	Jinhu County
Proportion of predicted new land area	0.009	0.050	0.151	0.121	0.118	0.123	0.148	0.131	0.150
Weight allocated when the internal factors of land use are included	0.026	0.050	0.124	0.115	0.117	0.124	0.152	0.143	0.148
Weight allocated when the internal factors of land use are excluded	0.064	0.074	0.136	0.131	0.142	0.135	0.095	0.127	0.097

3.3 Consideration of necessity about internal factors of land use Each region wants to get more land indicators, and often falsify the land indicators, so the land supply rate is low in various regions of Huai'an City. Then the new land area predicted by combination forecasting method is closer to the actual demand compared with the reported demand for land. Therefore, this paper selects the predicted new land area as a reference for comparative analysis. Based on the above-mentioned method of calculating the weight allocated for each region, we calculate the weight allocated (N_i) when the internal factors of land use are excluded. Table 2 summarizes the weight information, and we do a comparative analysis between the proportion of predicted new land area in various regions and the weight allocated when the internal factors of land use are included and excluded, respectively. The degree of deviation of two curves is calculated in Equation (7).

$$\Delta q = \sqrt{\sum_{i=1}^{t} (y_i - x_i)^2} \tag{7}$$

where Δq is the amount of deviation; y_i is the weight allocated in region i; x_i is the proportion of new land area in region i.

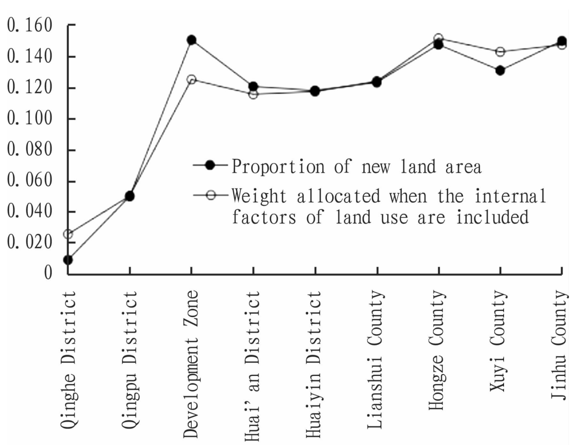

Fig. 2 Comparison between the weight of different regions when the internal factors of land use are included and the proportion of predicted new land area

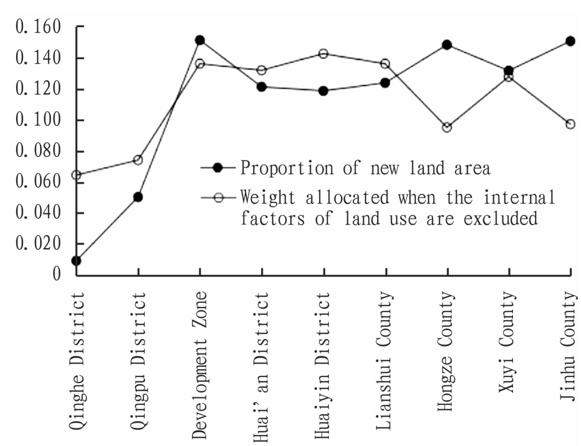

Fig. 3 Comparison between the weight of different regions when the internal factors of land use are excluded and the proportion of predicted new land area

The amount of deviation (Δq_1) of the weight allocated (M_i) when the internal factors of land use are included from the proportion of predicted new land area is calculated to be 0.0334; the amount of deviation (Δq_2) of the weight allocated (N_i) when the internal factors of land use are excluded from the proportion of predicted new land area is calculated to be 0.1042. Obviously, the amount of deviation of the weight allocated when the internal factors of land use are excluded is much greater than the amount of deviation of the weight allocated when these factors are included, so the weight allocated after adding the internal factors of land use is more in line with demand. The comparison between two curves and reference is shown in Fig. 2 - 3.

4 Conclusions

The allocation results calculated by entropy weight method and AHP are in line with the actual situation, and the study results have certain guiding significance to the allocation of new construction land indicators in Huai'an City, and provide a new theoretical approach for reasonable allocation of new land indicators. In allocation of new construction land indicators, the integrated use of entropy method and AHP can reasonably play the advantages of both methods, so as to improve the rationality of weight allocation. The impact of internal factors of land use is reasonably considered to make the evaluation indicator system more comprehensive. At the same time, we use the actual data to verify that after considering the internal factors of land use, the evaluation indicator system becomes more comprehensive and the allocation results are more in line with the actual situation, thereby avoiding the deviation of land use indicator allocation from actual land use situation.

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Sciences, the drought resistance index of Cangmai 028 in 2007 was 1.015, and it was 1.085 in 2008, showing intermediate drought resistance.

4.4 Disease resistance According to the disease resistance identification by the Plant protection Institute Hebei Academy of Agricultural and Forestry Sciences, Cangmai 028 was intermediately resistant to Puccinia striiformis and Sphaerotheca fuliginea in 2007 and 2008.

4.5 Nutritional quality According to test of Inspection and Testing Center for Quality of Cereals and Their Products, Ministry of Agriculture of People's Republic of China in 2009, the crude protein (dry base) was 13.38%, wet gluten was 26.5%, settlement value was 15.8 mL, water absorption was 59.8%, the formation time was 2.2 min, and stability time was 1.4 min.

4.6 Drought resistance and saline and alkaline resistance In Jiaxiang Village of Huanghua City in Cangzhou, the salt content of soil was 0.32%. Through field measurement, the average ear number was 3.675 million / ha, the number of grain per ear was 31.1, the weight of one thousand grain was 40 g. In these conditions, the yield was 3885.90 kg/ha. Compared with the control group Cangmai 6001, the yield of Cangmai 028 increased about 687.90 kg/ha, increasing about 21.5%.

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