A New Methodology to Quantitatively Define Major Function Oriented Zones of County: The Case of Libo County

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Keywords: Major function oriented zones, Regional development, State space method, System clustering, County.

Abstract. Major function oriented zones (MFOZ) is the new method of spatial regulation for re-shaping regional development pattern in China. County is an important part of the system of administrative divisions, and it is also the key areas of the adjustment of spatial patterns. This paper attempts to put forward MFOZ of county based the state space method which mainly used in the field of theory of ecological carrying capacity. It is established the major functional index by used the state space method and determine the limit threshold and spatial distribution of MFOZ. Considering the layout of the county economy and land use and similar functional area concentration or dispersion degree, MFOZ of Libo county should be divided into four types, namely suitable development zone, moderate development zone, ecological protection zone, prohibition development zone. Compared with the traditional system clustering method, The result of the state space method is more practical. MFOZ can provide a theoretical basis for the sustainable development of Libo county.

Introduction

China’s 11th Five-Year Plan calls for the major functional oriented zones (MFOZ)in the whole country, which is to distinguish four kinds of principle section from the whole country, namely optimal development zone, key development zone, restricted development zone and prohibited development zone. At present, method for major function oriented zones is regular use by criterion and index system. Existing index system quantification method including these: Correlation analysis method, the leading mark method, convergence analysis, association table mutually exclusive classification matrix method[1], magic cube 3D graph analysis method[2], state space method[3-4], regional bearing force[5], matrix cluster and gradually merging quantitative model method[6-7], expert integration of qualitative analysis, the final classification evaluation matrix method[8-10]. this paper attempts to put forward MFOZ of county based on capacity of resource and environment, capacity of ecological, existing development intensity and potential of development. After that, the threshold value of the ecological, environmental were used by the state space method and principal component analysis method. Eventually, the ecological, life, production space were divided by the threshold. The preliminary scheme of MFOZ have completed. Comparing with MFOZ result which divided by System clustering, further modified MFOZ of Libo county and accomplish final project. MFOZ of Libo county achieve the purpose of balancing "development" and "ecology".

Methods

Divide Index of MFOZ

Divide index system of MFOZ of Libo county was constructed from 16 indicators, by analysis the Libo county ecological environment quality characteristics, resource conditions and environmental
capacity constraints and human activity intensity. A set of indicator framework for MFOZ was established in such three aspects as the resource carrying capacity index, ecological carrying capacity index and development potential (Figure 1). Using SPSS19.0 as the platform, the Z-score method is used to deal with all the original variables and eliminate the dimension of the original data. The main components of the 16 factors were analyzed, the correlation coefficient matrix was obtained, and the characteristic values and the contribution rate of each principal component were calculated.

**Divided Method in State Space Model**

The state space method is applied to determine MFOZ of county, which used in the field of bearing capacity theory research, and constructing the major function index (MFI) model. The state space method is the different bearing conditions of the study area in a certain time scale. The size of the region carrying capacity is obtained by the vector modulus of the origin of the state space. The mathematical expression of the state space method is the formula (1).

\[
RCC^{\text{MFOZ}} = RCC - M = \sqrt{\sum_{i=1}^{n} w_i^2 \cdot (w_i \cdot RCS)^2} \quad M = \sqrt{\sum_{i=1}^{n} (w_i \cdot RCS)^2} \quad \text{RCC} = \sqrt{\sum_{i=1}^{n} (w_i \cdot RCC_i)^2} = \sqrt{\sum_{i=1}^{n} w_i^2}
\]  

(1)

RCC is size of area carrying capacity, M is a quantitative representation of the regional development, RCCi is the ideal value of the regional system, W for the RCCi axis of the weight (using the principal component analysis score as its numerical value), RCS, is the present value of the time period for the regional system. Comparison of RCC and M values, can determine the actual situation of the region: Sustainable carrying capacity when RCCsus>0 or RCC>M, when RCCsus=0 or RCC=M, sustainable carrying capacity, when RCCsus<0 or RCC<M is overloaded.

According to the previous research [12], RCC, M, and major function index is a good positive correlation, set: \( MFI = \arccos(M / RCC) \) \((0 \leq MFI \leq 90)\)

**Divided Method in System Clustering**

More scholars use clustering algorithm to divide the main function oriented zones. Clustering analysis is an important method to quantitatively study the classification of geographical objects (phenomenon) and the problem of geographical area. System clustering is one of the common clustering analysis method. Suppose there are m objects, each of which has n elements \((X_1, X_2, ..., X_n)\), the distance is the basis and the basis of the system clustering analysis, and the Euclidean distance is usually chosen as the non similarity index, set:

\[
d_{ij} = \sqrt{\sum_{i=1}^{n} (x_{ia} - x_{ja})^2} \quad i,j=1,2,\cdots, m
\]

MFOZ of county use system clustering method, according to the resource carrying index, the ecological carrying capacity index and the development potential. Using clustering distance to distinguish the type of main functional area.

**Case Analysis**

**Study Area**

Libo county is located in the south of Guizhou province, the Guizhou plateau and the staggered zone of the Guangxi hills, Longitude 107°37′ — 108°18′ E, latitude 25°7′ N—25°39′ N. The total area of county is 2415.45km² and the total population of County has been 181600 by the end of 2013, including 24 minorities Buyi, aquarium, Miao, Yao, Dong, Zhuang. It belongs to “China Southern Karst” world natural heritage, the National key ecological function area demonstration pilot area.
MFOZ Based on the State Space Model

Adhere to two bottom line of the relationship of the development and ecological. Using the state space method to establish MFOZ index model, and according to the major function index (MFI) to identify different types of MFOZ of township. At the same time, MFOZ of Libo county by the system cluster, in order to verify the results by the state space model. The Preliminary plan has been completed. Finally, prohibited development zone added on the consequence of the preliminary plan, finishing the final plan. Using SPSS19.0 to analyze the sample, the correlation coefficient matrix, characteristic root, principal component contribution rate, cumulative contribution rate and principal component load were obtained. The contribution rate of the main components of the first 4 characters has reached 85.898%. That is, Degree of resolution of the first 4 principal components of MFOZ of Libo county have reached more than 80%. The main driving force of the 4 main components and their characterization can be used as the main driving force of major functional oriented zones of Libo county, and it also can be used as a new index for evaluating major functional oriented zones of Libo county. In this paper, the 4 main components are recorded as $Z_1$, $Z_2$, $Z_3$, $Z_4$. From loadings matrix of the principal components, the correlation between principal component factors and the original index was found. It is known that the main driving force of MFOZ of Libo county is 4 aspects. Principal component factor 1 mainly related to the natural environment and the ecological environment; Principal component factor 2 is the land development intensity index; Principal component factor 3 is related to the rocky desertification area index; Principal component factor 4 mainly related to social and economic factors.

![Figure 1. Indicator system of Major Function Oriented Zones in Libo county.](image)

![Figure 2. Principal component analysis score.](image)

Using principal component analysis to get the score of each principal component factor in each township. The highest comprehensive score of the township is Yuping and Chaoyang, which is located in the county's political and economic culture and trade center area, It’s an important
population and economic intensive areas (Figure 2). Principal component factor score of each township were generated into the formula (1) to calculated the major function index of each township. The main function index of each township is different, But the results of the division are in general agreement with the economic and social development in Libo county. At present, there is no optimal development zone in the major function oriented zones of Guizhou province. The spirit of "all parts can be set up in the region according to the actual situation of the local area", major function oriented zones of Libo county are divided into Suitable development zone, moderate development zone and ecological protection zone. Suitable development zone refers to the focus of the development zone has yet to reach the national level, but the important growth pole of county or regional economic growth, undertake industrial transfer and population transfer to another area, Suitable development zone of Libo is MFI index greater than 80, that is Yuping and Chaoyang; Moderate development zone refers to limit development zone field producing agricultural products, to provide agricultural products as the main body function, has a good agricultural production condition, the need to limit on a large scale high strength industrialization urbanization development, so as to maintain and improve the ability of agricultural production. moderate development area of Libo is MFI index between 60 and 80, that is Jialiag, Xiaqikong, Jiarong, Maolan; ecological protection zone refers to limit development zone domain key ecological function areas, ecological security, maintain and improve the ability of ecological products supply important area, demonstration area of harmony between man and nature. ecological protection zone of Libo is MFI index below 60, that is Limignguan and Yaoshan.

MFOZ Based on System Clustering

System clustering is an important method to quantitatively study the classification of geographical objects and the geographical zone. It can be seen from the cluster analysis pedigree chart that clustering results are different under different clustering distance. When the distance is 0, each sample as a separate category, namely 8 township as a unit for each standard. When the distance is gradually enlarged, 8 townships in clustering. It can be seen from the pedigree chart that the smallest distance town is between Chaoyang and Yuping (called class I) which are fast together as a class. Yaoshan and Lingmingguan also clustered together, and thereafter Jiarong clustered into them (referred to as class II). Selection of clustering distance is 10, then Maolan get together with class I. Further expanded the clustering range to 15. The 8 regional units can be divided into 2 groups. Finally, when the clustering range expanded to 25, 8 regional units were clustered into 1 categories. The clustering process shows that Chaoyang town and Yuping is similar, classified as suitable development zone, and Yaoshan, Lingmingguan and Jiarong gather for a class with faster speed, which called as ecological protection zone. Jialiag, Xiaqikong and Maolan are classified for moderate development zone.

Conclusion

Contrast MFOZ of Libo county by using the state space method and system clustering method. It can be seen that the former is higher agglomeration degree than the latter. And the state space method calculated the threshold of MFOZ of each township. This method is more reasonable. Such as Jiarong was divided into ecological protection zone by systemic clustering, it classified as moderate development area by state space method, which is more in line with the actual situation of Libo county. Restricted by social economic development statistics data, MFOZ of Libo county focus on key development zone, restricted development zone and prohibited development zone, Not involving optimal development zone. Therefore, MFOZ should be refined and modified, especially some special functional areas and the boundaries of prohibited development zone, in order to make the results of MFOZ consistent with the actual situation in Libo county. Through the comprehensive comparison of the above two methods, combined with the results of the present zoning plan, further modified the units of the division, and Final achieve the finally plan of MFOZ. Yuping, Chaoyang were bring into the suitable development zone, Jialiag, Jiarong, Xiaqikong, Maolan were divided into the moderate development zone, Limignguan and Yaoshan except the prohibition of the
development area outside were contain in the ecological protection zone and the core area and buffer zone of the world natural heritage were belong to Prohibited development zone. State space method is more degree of clustering and dispersion of the same functional area then system clustering method. The result is more in line with the actual situation of Libo county. The research shows that state space method is feasible and reasonable. Reasonable Achievements of MFOZ can provide a theoretical basis for the sustainable development of Libo county.

Acknowledgments
In this paper, the research was sponsored by the National Basic Research Program of China (973 Program, Project No.2012CB723202), The major application foundation research project of Guizhou Province (Guizhou S&T Contract JZ 2014-200201), National natural science foundation of China (Grant No: 41301504),The major education department project of Guizhou province (Guizhou Education Cooperation Contract KY 2012-7022), the International Scientific and Technological Cooperation Plan Projects of Guizhou Province (Guizhou S&T International Cooperation Contract G 2012-7022), Soft science research project of Guizhou Province (Guizhou S&T Contract R 2014-2012).

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