Research of Ecological Carrying Capacity ---Comprehensive Evaluation Model

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Abstract

The indicators of ecological carrying capacity---comprehensive evaluation model was deeply analyzed and studied. Combining with the demand of sustainable development, introduce the advantages and disadvantages of ecological carrying capacity---comprehensive evaluation model. The indicator system, weight definition and data acquisition of the comprehensive evaluation model is analyzed deeply, and then propose three suggestions of them in hopes of objective assessment of ecological sustainable development in new period.

Keywords: Ecological Carrying Capacity; Sustainable development; Comprehensive evaluation model; weight; ecological system

1. Introduction

As the basis of sustainable development, study of ecological carrying capacity promotes the implementation of sustainable development. In the past, study of carrying capacity is studied usually as single element, such as carrying capacity of resources, environmental capacity and so on, which ignore the integrate effect of ecological system. It tends to consider only one part and ignores the other parts, which lead to break ecological balance, deteriorate ecological system, and finally, turns out to be unsustainable development including the human species. Only take the whole ecological system as the study object, on the premise that structure and function of ecosystem are not deteriorated, figure out the maximum capacity of ecological system to human activities, can we define exploitation intensity reasonably, and then build a whole and practical sustainable development model for social economy. Therefore, in terms of sustainable development, it is of vital significance to take a study based on ecological carrying capacity. An overall view of the study methods of ecological carrying capacity will show that ecological carrying capacity --- comprehensive evaluation method plays a very important role in sustainable development study.
2. Comprehensive evaluation model

Ecological carrying capacity-comprehensive evaluation method divides ecological system into support layer and pressure layer. Support layer consists of three aspects, namely, ecological elasticity, carrying capacity of resources and environmental capacity. Pressure layer is presented by population carrying capacity and corresponding living standard. The specific index system of the model is shown as Fig. 1.

![Indicator system of comprehensive evaluation model](image)

2.1 The advantages of comprehensive evaluation model

(1) Comprehensive evaluation model includes plenty of indicators, and studies comprehensively on region economic and social development combined with population, sources, ecological environment closely, which covers noodles wide, and is very comprehensive.
(2) Calculation of indicators is classified, which result have a great relevance. By classification of indicators, it is easier to reason calculation results of carrying capacity, and then we can take the corresponding and pertinent measures, which is conducive to the sustainable control.

2.2 The disadvantages of comprehensive evaluation model

1) Negativity of indicator establishment

In support layer, ecological carrying capacity of the nature itself is the main part, comprehensive evaluation model lists some native indicators of ecological carrying capacity, but neglects special role of advanced technology in promoting ecological carrying capacity. In pressure layer, take the population indicators, social indicators, economic indicators and so on, as the main part, but neglects the influence of man's subjective initiative and its organization function to carrying capacity, which produces a larger relative error of evaluation results.

2) Subjectivity of weight establishment.

After selecting the indicators, the comprehensive evaluation model adopts analytic hierarchy process to define the value and weight of the indicators. Analytic hierarchy process is subjective to weight multiple indicators, which is depended largely on experience, with big influence of subjective element. Analytic hierarchy process only excludes inconsistency in thought processes, but fail to avoid the possible one-sidedness of decision maker. Therefore, it is always of subjectivity and arbitrariness to define the value and weight by using analytic hierarchy process, and then produces error of evaluation results.

3) Low data availability.

Though comprehensive evaluation model covers noodles wide, it is hard to obtain the lowest indicator data, such as the secondary indicator of hydrological indicator, evaporation; the proportion of various kinds of soil (red soil, black soil, paddy soil, brown soil and so on) in edaphic indicator. These data are obtained generally by remote sensing technology and professional geological exploration, which is not practical to small, limited areas without related technology and service.

Referred to biological energy, they are solar energy, wind energy, tide energy, temperature difference energy, geothermal energy, wave energy, waste energy and so on, aside from traditional energy. It is of importance for relieving the acute shortage of traditional energy and reducing the environment pollution to develop and use new energy. With the raising of living standard, the coordinated development of kinds of education, the raising of the quality of medical service, the development of economy, the rapid increase of total social health and so on, people are more capable to improve ecological environment with better spiritual surplus, intelligence, physically strength, financial capacity, social potential, which also embody the progress of social in all respects and the human activity potential.

4) Pressure layer

With the exception of population indicator remained in pressure layer, the pressure layer should induct consumption indicator, environmental pollution indicator and ecological damage indicator. Play of man's subjective initiative, on one hand, promotes the social and the consequent ecological damage, which are embodiment of ecological pressure. Indicator system of improved comprehensive evaluation model is shown as Fig. 2.

2.3 Correction of weight

In analytic hierarchy process, the calculation of weight depends on expert-grading to define the correlation between factors, and then construct judgement matrix, solve for maximum eigenvector by judgement matrix, solve for the weight of any factor by maximum eigenvector. In the process, expert-grading is the sole determinant to define the ultimate weigh, in order to avoid the influence of subjective
factors to weight calculation in analytic hierarchy process, we can replace analytic hierarchy process with principal component analysis.

Figure 2 Indicator system of improved comprehensive evaluation model

Principal component analysis has developed into a newer evaluation method, essentially, optimal policy mix and simplification of high dimensional variable system, and at the same time, define the weight of each indicator objectively. Comparing with other evaluation method, the advantages of principal component analysis are shown as below:

① It can eliminate influence between evaluation indicators. After transformation of primitive indicator variable, principal component analysis forms principal components which are independent from each other. Moreover, experience has shown that the higher the correlation between indicators, the better the principal component analysis.

② It can reduce workload of selecting indicators. In terms of other evaluation methods, for correlation between evaluation indicators is hard to be eliminated, it is take a lot of time and effort to select indicators, whereas principal component analysis is easier to select indicators, for it can eliminate influence between evaluation indicators.

③ Each of principal components in principal component analysis is sorted by variance size. In analyzing problems, we can neglect some principal component, just select some high variance principal component to represent primitive variable. That will reduce the workload.
2.4 Get basic data

Comprehensive evaluation method need more basic data, and the accuracy of obtained data influences the evaluation result directly, so it is better to get basic data by kinds of ways and comprehensive methods, such as using many times research fieldwork, consulting Yearbook, combining remote sensing technology (RS) and geographical information system (GIS), which will control the change of evaluation region from different directions and get the reliable data.

3. Conclusions

In terms of three factors, selecting indicator, getting data and defining weight of ecological carrying capacity-comprehensive evaluation model, this paper tries to improve the model deeply.
1. Objectively divided human activity into two aspects, potential and pressure, and induct ecological carrying system, select corresponding indicator to study ecological carrying capacity quantitatively.
2. To avoid the subjective influence from defining weight in analytic hierarchy process, we suggest adopting principal component analysis.
3. In order to get a more accurate evaluation result, encourage to use kinds of ways to get accurate and comprehensive data.

By the innovation mentioned above, we expect to have an objective and accurate understanding of the mutual effect mechanism in ecological system, and get a more scientific evaluation result. Although there is some aspects need improvement in comprehensive evaluation model, they are mere little flaw, system theory and comprehensive evaluation model are promising in the study of carrying capacity, which are inevitable tendency to be used in studying region system carrying capacity and sustainable development at future.

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