

Effect Evaluation of Grassland Ecological Compensation in Inner Mongolia

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Abstract: *Effect evaluation of ecological compensation is indispensable part of the construction of ecological compensation mechanism. To explore the effects of grassland ecological compensation, in this paper, we review the practice of Inner Mongolia grassland ecological compensation in recent years and explore to establish quantitative effect evaluation system of grassland ecological compensation, scientifically evaluate the impacts of grassland ecological compensation policy to Inner Mongolia Ecological, economic and social, accurately evaluate the effects of the implementation of the Inner Mongolia grassland ecological compensation.*

Keywords: *Ecological compensation; effect evaluation; Inner Mongolia*

1. INTRODUCTION

Through consulting a large number of literature found that foreign researches and practices on grassland ecological compensation are not many. The researches of Chinese scholars are mainly reflected in the following aspects: the necessity of the grassland ecological compensation, standard of ecological compensation, mode of compensation and ways of implementation. At present, the researchers are still in the exploratory stage. Effect evaluation of ecological compensation is the foundation of building ecological compensation mechanism, Shan Wei (2009) used principal component analysis to build model to evaluate the overall effect of the ecological compensation of our country from 1996 to 2005, which provides a new feasible evaluation method for ecological compensation^[1]; Yue Siyu (2012) designed the index system of benefit evaluation of ecological compensation in Han River Basin to evaluate the effect of local ecological compensation^[2]; Tan Yingyu (2012) reviewed the practice and effect of ecological compensation in Zhejiang Province in recent years. A quantitative method of assessment on ecological compensation is discussed^[3]. In this paper, we review the practice of grassland ecological compensation in Inner Mongolia in recent years and explore to establish quantitative effect evaluation system of grassland ecological compensation, accurately evaluate the effects of the implementation of the Inner Mongolia grassland ecological compensation.

2. THE PRACTICE OF GRASSLAND ECOLOGICAL COMPENSATION IN INNER MONGOLIA

In recent years, facing severe ecological forms, Inner Mongolia has been carried out "Grassland restoration project", "The control of sandstorm in Beijing and Tianjin", "The subsidy and incentives of protection of grassland ecological", "The revitalization of the dairy industry, activities of alfalfa development", As well as other protection projects of grassland ecological. Those measures arouse the enthusiasm of the protection of grassland ecological environment and promote the improvement of the grassland ecological environment in Inner Mongolia.

3. CONSTRUCTION OF EVALUATION INDEX SYSTEM

Given the relatively few effect evaluation studies on grassland ecological compensation at home and abroad, in this paper, the construction of evaluation system of grassland ecological compensation in Inner Mongolia follow the general principles of the index system and refer to relevant literature of the effect evaluation of ecological compensation in river basin and forest and the evaluation of the sustainable development of pastoral areas, combining with the objective practical situation of grassland ecological compensation in Inner Mongolia ,we select 16 indicators as the underlying index to establish effect evaluation system of grassland ecological compensation in Inner Mongolia.

Table1. Effect evaluation system of grassland ecological compensation in Inner Mongolia

First-class index	Second-class index	Third-class index
Comprehensive effects evaluation	Economic development	Per capita GDP (yuan)
		Per capita food production (kg)
		Gross output value of animal husbandry (100 million yuan)
		Gross tertiary industry share of GDP (%)
		Total fixed assets (100 million yuan)
	Ecological environment	Total number of head of livestock (10000heads / only)
		Artificial grass to maintain area (million hectares)
		The average annual rainfall in major cities (mm)
		Barn area (10000 square meters)
		Fenced grassland area (10000 hectares)
		Area of nature reserves (10000 hectares)
	Social development	Net income of rural residents per capita pastoral households (yuan)
		Post and telecommunications business volume (10000yuan)
		Enrollment in Colleges and universities (person)
		Length of road transport routes (km)
		Hospital beds per 10000 population (unit)

4. CONSTRUCTION OF COMPREHENSIVE EVALUATION MODEL

4.1. The Definition and Application of Entropy Weight Method

Entropy weight method is defined as a method of assigning weights to the data. The specific calculation steps are as follows:

- (1) Determination of index weight P_{ij} . The evaluated matrix $X = [X_{ij}]_{m \times n}$ is set by the m programs and n indicators, then $P_{ij} = X_{ij} / \sum_{i=1}^m X_{ij}$, ($i = 1, 2, \dots, m; j = 1, 2, \dots, n$).
- (2) Entropy calculation of each index E_j . $E_j = -k \sum_{i=1}^m P_{ij} \ln(P_{ij})$, where: $k > 0$, $k = 1 / \ln(m)$, $E_j \geq 0$, if $P_{ij} = 0$, so $P_{ij} \ln(P_{ij}) = 0$.
- (3) Calculate the difference coefficient of index j -th, $G_j = 1 - E_j$.
- (4) Determine the entropy weight of each index W_j . $W_j = G_j / \sum_{i=1}^m G_j$, where: $\sum_{j=1}^n W_j = 1$

4.2. The Definition and Application of Grey Comprehensive Evaluation Method

The theory of grey comprehensive evaluation method is based on the principle of grey system. Grey incidence analysis is an important method in the study of grey system theory. By calculating the grey correlation degree to compare the advantages and disadvantages of different objects. The specific calculation steps are as follows:

(1) To determine the optimal index set. An optimal value is selected from the same index of different evaluation objects, and the optimal index set is composed of the optimal value of each evaluation index, denoted by $U^* = (u_{01}, u_{02}, \dots, u_{0n})$. Then set the optimal index set and other index set

together constitute the matrix $D = \begin{bmatrix} u_{0j} \\ u_{ij} \end{bmatrix}$, where: u_{ij} refers to the original index data of i -th evaluation object and the j -th index. ($i = 1, 2, \dots, m; j = 1, 2, \dots, n$.)

(2) The standardization of data. The method is data equalization, after the original value matrix $D = [u_{ij}]$ is standardized, the new matrix is $[V_{ij}] = \frac{u_{ij}}{\sum_{i=0}^m u_{ij}/m+1}$.

(3) Determination of evaluation matrix. The i -th evaluation object in evaluation model and the j -th index in optimal index set is calculated gray correlation coefficient.

$$L_{ij} = \frac{\min_i \min_j |V_{0j} - V_{ij}| + \rho \max_i \max_j |V_{0j} - V_{ij}|}{|V_{0j} - V_{ij}| + \rho \max_i \max_j |V_{0j} - V_{ij}|}$$

Where: ρ is a constant called distinguish coefficient, generally, we take its value of 0.5, the last evaluation matrix $R = [L_{ij}]_{m \times n}$ is composed of L_{ij} .

(4) Grey comprehensive evaluation. According to the weight matrix, the grey correlation degree of the evaluation object can be obtained, denoted by $B = W \times R^T$, where: $b_i = \sum_{j=1}^n W_j L_{ij}$,

The greater grey correlation degree is, the closer evaluation object is to the optimal index. According to the size of the grey correlation degree, we can divide the interval advantage, if $b_i \in (0, 0.35]$, it belongs to weak correlation; if $b_i \in (0.35, 0.65]$, it belongs to moderate correlation; if $b_i \in [0.65, 1)$, it belongs to strong correlation.

5. EVALUATION AND ANALYSIS OF EFFECT OF GRASSLAND ECOLOGICAL COMPENSATION IN INNER MONGOLIA

5.1. Data Sources and the Process of Comprehensive Evaluation

The data in this paper is mainly obtained from the annual statistical yearbook of China .

(1) Determination of index weight. According to the entropy weight method to determine the weight of each level index in the evaluation model. From the formula, the weight matrix is composed of second levels of the index, denoted by $W = (0.342, 0.287, 0.372)$, the weight matrix is composed of third levels of the index, denoted by $W_x = (0.250, 0.179, 0.219, 0.116, 0.235)$, $W_y = (0.141, 0.203, 0.121, 0.247, 0.114, 0.174)$, $W_z = (0.243, 0.163, 0.110, 0.191, 0.293)$.

(2) Determination of optimal index set. Select the maximum value in the 2000-2014 years as the index to form the optimal index set.

(3) Determination of evaluation matrix. According to the principle of grey correlation analysis, the comprehensive evaluation matrix of economic development, ecological environment and social development of Inner Mongolia are respectively R_1, R_2, R_3 .

(4) Grey comprehensive evaluation. According to the evaluation matrix, the comprehensive evaluation results of the three aspects of economic development, ecological environment and social development are respectively:

$$B_1 = W_x \times R_1^T = [0.361 \ 0.382 \ 0.412 \ 0.424 \ 0.433 \ 0.411 \ 0.420 \ 0.437 \ 0.484 \ 0.509 \ 0.553 \ 0.665 \ 0.802 \ 0.837 \ 0.916]$$

$$B_2 = W_y \times R_2^T = [0.377 \ 0.354 \ 0.403 \ 0.485 \ 0.580 \ 0.494 \ 0.435 \ 0.451 \ 0.487 \ 0.614 \ 0.684 \ 0.653 \ 0.651 \ 0.713 \ 0.858]$$

$$B_3 = W_z \times R_3^T = [0.336 \ 0.341 \ 0.342 \ 0.351 \ 0.365 \ 0.378 \ 0.430 \ 0.485 \ 0.551 \ 0.625 \ 0.579 \ 0.609 \ 0.661 \ 0.816 \ 0.924]$$

Then, the evaluation results from the above three aspects constitute the overall comprehensive

evaluation results. Comprehensive matrix is $R = \begin{bmatrix} B_1 \\ B_2 \\ B_3 \end{bmatrix}$. The results of the comprehensive effect

evaluation of grassland ecological compensation in Inner Mongolia are $B = W \times R = [0.357 \ 0.359 \ 0.384 \ 0.415 \ 0.450 \ 0.423 \ 0.428 \ 0.459 \ 0.510 \ 0.583 \ 0.601 \ 0.641 \ 0.707 \ 0.794 \ 0.903]$.

5.2. The Analysis of Results of Comprehensive Evaluation

The trend chart of grey relational degree of comprehensive evaluation, economic development, ecological environment and social development evaluation is as follows:

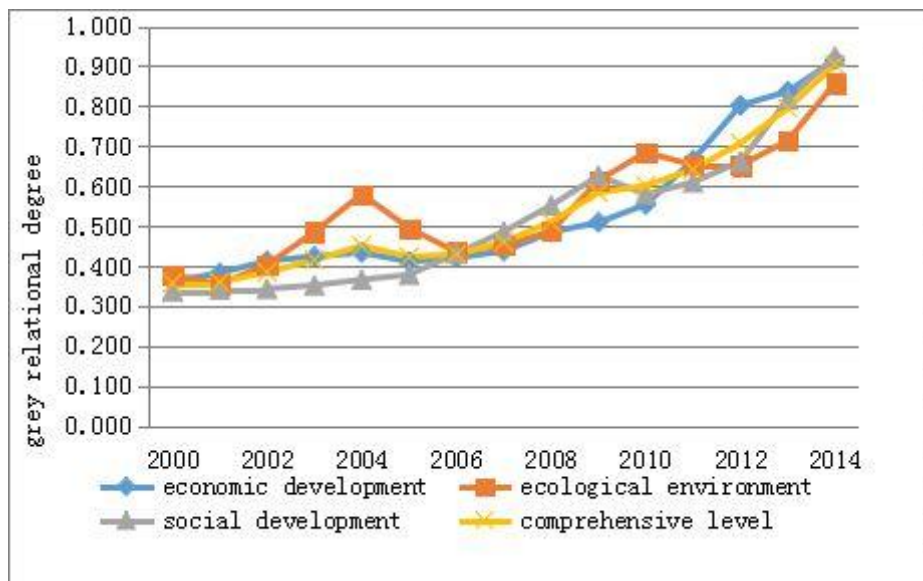


Chart1. Effect evaluation of Inner Mongolia grassland ecological compensation in 2000-2014

As can be seen from Chart 1, the comprehensive level, economic development, ecological environment and social development level of grassland ecological compensation in Inner Mongolia show an upward trend. Among them, the development of ecological environment is not stable enough. According to the principle of grey correlation degree, the economic development from 2000 to 2010 belongs to the moderate correlations, 2011-2014 belongs to strong correlations; ecological environment from 2000-2009 belongs to moderate correlations, from 2010-2014 belongs to the strong correlation; social development from 2000-2002 belongs to the weak associations, 2003-2011 belongs to the moderate correlations, 2011-2014 belongs to the strong correlations; comprehensive level of 2000-2011 belongs to moderate correlations, 2012-2014 belongs to the strong associations.

6. CONCLUSIONS AND IMPLICATIONS

Based on the construction of comprehensive evaluation index system, this paper makes an empirical study on the effect of grassland ecological compensation in Inner Mongolia by combining the entropy weight method and the grey comprehensive evaluation method. The following conclusions can be obtained through evaluation: Overall, in recent years, the effect of grassland ecological compensation is obvious in Inner Mongolia. There is a steady upward trend, especially after 2007, the effect of compensation is significant. The policies of national and local government in Inner Mongolia are crucial. In 2007, the government attaches great importance to grassland ecological compensation and put a lot of manpower, material and financial resources. Therefore, making the grassland ecological compensation of Inner Mongolia obtain relatively good effect. Although it has better compensation effect, there are also many problems and shortcomings, especially in ecological environment, the funds are not in place, supervision is not strict, implementation is not complete and other factors cause the grassland ecological environment compensation is not stable enough. In recent years, the work of grassland ecological compensation has achieved certain effect, but we must deeply realize the grassland ecological environment of Inner Mongolia is still relatively fragile, protection and construction of grassland, grassland to achieve sustainable development is still very arduous.

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