The Study of Ecological Service Value of Farmland Ecosystem in the Beijing-Tianjin-Hebei Region

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Abstract: The coordinated development of Beijing-Tianjin-Hebei Province has become major national strategy of the CPC central committee and the state council under the new historical conditions. The farmland of Hebei Province has made great contribution to food supply for Beijing and Tianjin in a long time. Hebei Province has played a more important role in the ecological function especially. The geographic grid method was adopted in this study to account the ecosystem service value of farmland in Beijing-Tianjin-Hebei region. The result showed that total farmland ecosystem service value in 2015 was 110.3 x 109 yuan and the proportion of ecosystem service value in Hebei Province was the highest which reached up to 92.56%. The results of the evaluation of ecological services could provide the basis for determining the ecological compensation standards for farmland in Beijing-Tianjin-Hebei region.

1. Introduction
As the publication of 'The Plan for The Collaborative Development of Beijing-Tianjin-Hebei Province' and 'The Coordinated Development for Modern Agriculture Planning(2016-2020) of Beijing-Tianjin-Hebei Province', the coordinated development of Beijing-Tianjin-Hebei Province has become major national strategy of the CPC central committee and the state council under the new historical conditions.
There is the phenomenon of the struggle of industrial and agricultural land, urban and rural land in the Beijing-Tianjin-Hebei Province region with the high-speed economic development, the agricultural
overall value of the Beijing-Tianjin-Hebei Province region was not fully reflected in the value of the national economy accounting system. Agricultural products output were accounted only. As one of three ecological systems of global land, farmland ecosystem has provided important role in local and national grain security, job security for the farmers, rural natural habitat, also with a certain maintenance of biodiversity, air purification, water conservation and the function of regulating climate, etc.[1]. The farmers directly got few agricultural economic value and service value as farmland in contribution to the huge ecological service value. The theory and practice are all looking forward to the establishment and implementation of ecological compensation mechanism in Beijing-Tianjin-Hebei Province region.

Administrative geographic units at various levels of farmland ecosystem service function value and evaluation method has been unified in Beijing-Tianjin-Hebei Province region. Based on this, the total value of farmland ecosystem were calculated so as to provide the basis for determining reasonable compensation standard for the farmland.

2. Ecosystem Services Classification and Standard Value Determination

The scientific ecosystem services classification and the standard value of value are the prerequisite for evaluation and application.

2.1. Ecosystem services classification

Ecosystem services came from the ecological system of logistics, energy flow and information flow[2]. At first, complex structure and process should be decomposed into limited number of functions which should be able to produce the profits including resources supply, environmental control, cultural entertainment and etc.

Costanza and others divided ecosystem services into 17 categories and identified the standard value of services early. The primary function of ecosystem services could be divided into four categories which were the support service, supply service, adjust service and culture service according to the Millennium Ecosystem Service Assessment (MA). 11 kinds of the secondary function had been divided further according to the research results of experts like Xie G D[3].

Supply services were divided three secondary types which included food production, raw material production and water supply. Adjustment services were divided 4 secondary types which included gas regulation, climate regulation, purification environment and hydrological regulation. Support services were divided three secondary type which included soil conservation, nutrient recycling and maintenance of biodiversity. Cultural service mainly included a secondary type of aesthetic landscape service.

According to the relation between supply and demand of the ecosystem and the human society, the value of ecosystem services were divided into market value and non-market value by Costanza and etc[4]. Market value was the value of ecosystem services which could be reflected or achieved in market mechanisms, including food and raw materials. The non-market value played a very important role for human beings without the value of ecosystem services that are reflected in the market mechanism.

2.2 Equivalent Factor of Ecological Service Value

Per unit area equivalent factor table of ecosystem service valuereflects the various ecosystems and the
ecological service function of the national average service value in the year. The reasonable equivalent factor table is the premise and foundation which could manifest district space difference and years time of the value of ecosystem services[5]. This research revised Chinese secondary ecosystem services value equivalent factor table mainly according to ecosystem services value evaluation result by Xie G D. The net profit of grain production per unit area about farmland ecosystem was a standard equivalent factor of ecosystem services value according to processing methods by Xie G D. The grain yield of the farmland ecosystem was calculated based on the main products of rice, wheat and corn. To make the farmland ecosystem service value more accurate measurement results, the equivalent factor should been modified because equivalent factor was used for the national grain yield data[6].

The following formula is used.

\[ Y = \frac{x_1}{x_2} \times Z \]

\( Y \) stands for the equivalent factor of field ecosystem services value in the study area, \( x_1 \) stands for the average grain yield in the study area, \( x_2 \) stands for the national average grain yield, \( Z \) stands for the unit area equivalent factor of farmland ecological service value in China's land ecosystem.

The economic value of the standard ecosystem Eco-service value equivalent factor reflects the potential ability of the ecosystem to contribute relative to the ecological service[7]. Classification of ecosystem services and equivalent factor tables were adopted and adjusted by "production method". The natural food production of cultivated land per unit area in Beijing-Tianjin-Hebei Province region was taken to adjust the economic value and the equivalent factor of the Beijing-Tianjin-Hebei Province region were determined.

Grain yields per unit area and food prices in 2015 had been consulted to revise the equivalent standard ecosystem services value factors which was 3651.8 yuan/hm² of Beijing-Tianjin-Hebei region. As a special agricultural ecosystem, greenhouse ecosystem was not considered in this study.

3 Methods of Ecological Service Value Accounting for Farmland Ecosystem

The geographic grid method were adopted to achieve the spatial expression of the ecological service value in this study[7]. The vector data was handled by geographic grid and each grid cell was a regional ecological service value of internal statistics unit cell. The value of each type of ecological service in each grid was calculated and the statistical results was the value of the ecological services provided by all the coverage types in the grid[8].

\[ V_i = \sum_{j=1}^{12} A_{ij} * V_{ij} \]

\( V_i \) stands for the value of ecological services in the grid \( i \); \( A_{ij} \) stands for the area of type \( j \) in the grid \( i \); \( V_{ij} \) stands for the ecological service value of the type \( j \) in the grid \( i \).

4. General Situation in the Study Area

The region of Beijing-Tianjin-Hebei Province covers an area of 216,000 square kilometers with a total population of 10865,000. It is the core of the political, economic and cultural development of our country area and urbanization level is high, which has become the third most dynamic city cluster in
our country after the Yangtze river delta and the pearl river delta. It is the highest level of economic development in north China area[10].

The region of Beijing-Tianjin-Hebei Province involves Beijing and Tianjin municipalities directly under the central government and 11 cities in Hebei Province which included Shijiazhuang, Tangshan, Qinhuangdao, Baoding, Cangzhou, Langfang, Handan, Zhangjiakou, Hengshui, Xingtai.

In this study six districts were amalgamated into Beijing downtown which included Dongcheng, Xicheng, Haidian, Chaoyang, Fengtai and Shijingshan. Ten districts were amalgamated into Tianjin urban area which included Six zones within, Dongli, Xiqing, Jinnan and Beichen.

Farmland area of Beijing in 2015 was 1.375 million hectares, accounting for 8.2 percent of the land area and 1.93 percent of the area in the Beijing-Tianjin-Hebei region.

Farmland area of Tianjin in 2015 was 389,000 hectares, accounting for 32.6 percent of the land area and 5.45 percent of the area in the Beijing-Tianjin-Hebei region. Hebei province has 660.6 million hectares of farmland, accounting for 35.0% of the land area and 92.62% of the total area of the Beijing-Tianjin-Hebei area.

5 Results and Discussion

5.1 Results

5.1.1 Ecological Service Value of Farmland Ecosystem in the Beijing-Tianjin-Hebei Region

The total farmland ecosystem service value of Beijing-Tianjin-Hebei Region in 2015 was 110.3 x 10^9 yuan. The proportion of total farmland ecosystem service value in Beijing was 2.18% and Tianjin proportion was 5.26%. The highest proportion in Hebei Province was as high as 92.56%. The value of ecological services provided by farmland in the Beijing-Tianjin-Hebei region is enormous which was 15464.4 yuan per hectare.

5.1.2 Total Value of Different Services in the Beijing-Tianjin-Hebei region

The value of farmland regulation service in the Beijing-Tianjin-Hebei region was calculated as high as 39.45 x 10^9 yuan, accounting for 35.8 percent of the total value of farmland ecological services. The second was support service and supply service, accounting for 31.8% and 30.9% of the total value of farmland ecological services. Cultural service was the least valuable, accounting for only 1.5% of the total value of farmland ecological services.

5.2 Discussion

When the ecological compensation policies is formulated, we should realize that the reality of ecological compensation ability is hard to meet in the ecosystem service[11]. Because of the influence of the economic development gap, the data is often beyond the jurisdiction of the government's fiscal capacity. Therefore, it is only as a reference and theoretical reference for ecological compensation when determining the standard of lateral financial transfer in practice.
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