

# Analysis on the Characteristics and Influencing Factors of Ecosystem Service Value in Beijing

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**Abstract:** Beijing is the center of political, cultural, international exchanges and scientific and technological innovation. With economic development rapidly, its ecological value and rational utilization of resources have also attracted much attention. The study uses GIS to conduct data processing and statistical analysis, and after coefficient correction, it has established the service value table of Beijing land ecosystem per unit area in different years to estimate the service value of different ecological assets to evaluate Beijing policy. The study shows that ESV presents the overall characteristics of declining before the rising, the ecosystem service value at the end of the research period is lower than the beginning of the period, and the changes of the ecosystem service value in Beijing are analyzed combined with relevant policies. In conclusion, the article puts forward that Beijing should continue to focus on the ecological environment, improve residents' awareness of environmental protection, and continue to improve the ecosystem service value evaluation system and other corresponding policy suggestions.

**Keywords:** ecosystem services; value assessment; ESV; land uses

## 1. Introduction

As the capital of China, Beijing is located at 39°56' n, 116°20' e. referred to as "Beijing", is a provincial administrative region, municipality directly under the Central Government of the People's Republic of China, is the political and cultural center of the country. Beijing is located in North China, adjacent to Tianjin in the east, and the rest are adjacent to Hebei, with a total area of 16,410.54 square kilometers. Beijing is high in the northwest and low in the southeast, surrounded by mountains in the west, north, and slowly tilted toward the Bohai Sea in the southeast. Up to now, a total of 16 municipal districts in Beijing, which respectively bear different functions and utilities for the capital. Since the reform and opening up at the cost of the ecological environment has brought serious impact can't be ignored, in order to better balance the relationship between economic development and ecological environment, Beijing introduced a series of policies to accelerate the construction of ecological

civilization, at the same time by measuring the ecosystem service value to make ecological development closely together with people's life.

Since 1997 [1] "global ecosystem service value and natural capital" published in the journal nature has been widely recognized, in many aspects of ecosystem services have made some research results, at the same time, many domestic scholars also began to study in this direction of the ecosystem service value. However, Costanza method is not fully applied to China's ecosystem value evaluation, has been controversial in the evaluation process. In 2008, Xie Gaudi [2] published "An ecosystem service value change method based on expert knowledge" in the Journal of Natural Resources, a research method based on Costanza's research content and combined with the ecosystem and socio-economic conditions has been widely recognized and applied in China. At the same time, Sun Menghua [3], Jiao Chunmeng [4] and Wang Jiao month [5] to derive the impact of their changes on ecosystem services value through the analysis of the studied regional land use value, et al. Although there are different types of research contents on ecosystem service value, due to its special political and economic status, Beijing has paid relatively little attention to it, especially from the policy perspective. On the basis of "ecosystem service value improvement method based on unit area value equivalence factor", the article summarizes the existing research methods [6], The ecological service value equivalent of Beijing is calculated by coefficient correction of Beijing years and ecosystem service value, combined with various policies in the studies year of ecosystem change process in Beijing.

## 2. Methods and Data

### 2.1. Accounting of Ecosystem Service System Value

Combined with the processing method of Xie Gaudi et al., and drawing on the existing research results of the net profit of farmland ecosystem food production as the ecosystem service value of one standard equivalence factor, the economic value of the ecosystem service value of one standard equivalence factor is 3406.5 yuan / hm<sup>2</sup>. The mature ratio of the grain output of the unit area and the study area is as follows:

$$\alpha_i = \frac{f_i}{F_i}, i = 1, 2, 3, 4, 5, 6 \quad (1)$$

Among them,  $\alpha_i$  indicate the correction coefficient,  $i = 1,2,3,4,5,6$  indicate year of 1995,2000,2005,2010,2010,2015,2020;  $F_i$  indicate national grain output per unit area in the same period (kg/hm<sup>2</sup>),  $f_i$  indicate grain yield per unit area for a given year in the study area (kg/hm<sup>2</sup>).

According to existing studies, excluding urban and rural, industrial and mining, residential land, and unused land, Finally, the land is divided into four categories: farmland, woodland, grassland and water area, farmland including dry land and paddy land, Woodland includes woodland, scrubforest, sparse woodland, other woodland. Grassland includes highly covered grassland, covered grassland and low covered grassland. The water area includes river channels, reservoirs, beaches and glacial snow, which is unified as a water system, constructing table of ecosystem service value per unit area of Beijing.

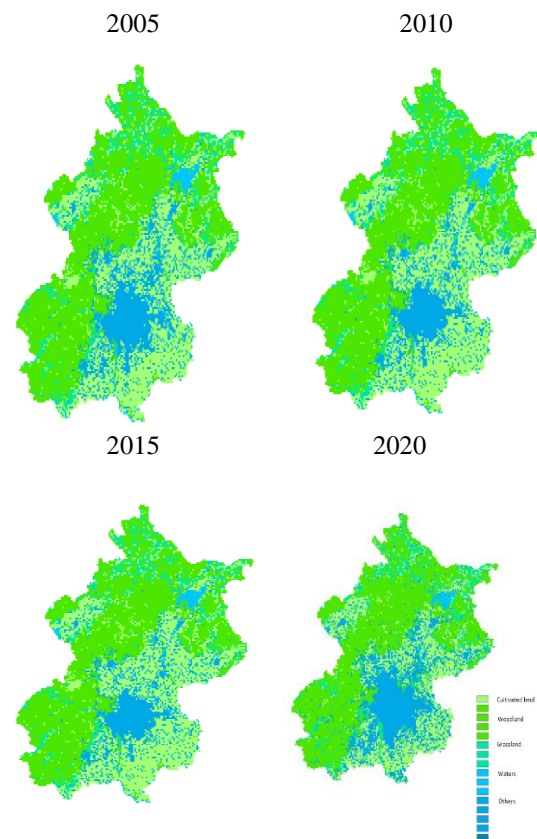
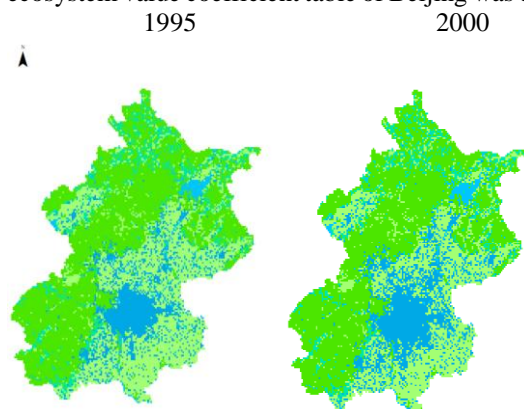
The ecosystem service value and change rate in Beijing are calculated through the following formula.

$$ESV = \sum_{k=1}^n(LUC_k \times VC_k) \quad (2)$$

Among them,  $ESV$  indicate the ecosystem service value (RMB);  $LUC_k$  indicate the area of land uses' type  $k$  (hm<sup>2</sup>);  $VC_k$  indicate unit area ecosystem service value (RMB / hm<sup>2</sup>) of land uses' type  $k$ ;  $n$  is the number of land use types in each region.

### 2.2. Data Source

The agricultural economic data used in this study were obtained from the National Statistics. Land use's type data came from visual data processed by GIS from the Resource and Environmental Science and Data Center of the Chinese Academy of Sciences. By introducing the value equivalence compiled by Xie Gaodi et al. (2003, 2008), and determining the correction coefficient of Beijing according to the mature ratio of grain output per unit area and grain output in the national study area, the ecosystem value coefficient table of Beijing was compiled.



**Figure 1.** Area of land use in Beijing from 1995 to 2020

### 2.3. Results

According to the land uses' type division standard of Resources and Environmental Science and Data Center of Chinese Academy of Sciences, Combined with the actual situation of Beijing, the construction land and unused land providing less ecological services and not providing ecological services were eliminated. Finally, the land is divided into farmland, woodland, grassland and water area, and combined with the Millennium Ecosystem Assessment (MA), the ecosystem services are divided into four primary service types: supply, regulation, support and culture. The subdivision standard refer to Xie Gaodi [3] based on the above methods,  $ESV$  in 1995, 2000, 2005, 2010, 2015 and 2020 can be obtained. (Table 1 and Table 2)

From content analysis, adjustment service is always the core function of Beijing ecosystem service; accounting for more than 75% of total ecological value, supply service, support service and cultural service shall not exceed 25% of total ecological value; From numerical analysis,  $ESV$  presents the overall characteristics of declining first, lower ecosystem service value at the beginning of the period. Among them, the  $ESV$  value of water and woodland land use type accounts for more than 80% of the total value, which plays a decisive role in the ecological value of Beijing.

**Table 1.**  $ESV$  values of different land use types

	1995	2000	2005	2010	2015	2020
cultivated land	39271.15	30538.95	29609.66	28778.08	30048.80	30303.54

Woodland	391667.57	304577.67	295309.48	287015.79	299689.21	302229.90
Grass	179901.63	139899.30	135642.21	131832.74	137653.92	138820.92
Water	675463.75	525269.88	509286.10	494982.93	516839.33	521220.95

**Table 2.** Different service type ESV values

Level 1	Level 2	1995	2000	2005	2010	2015	2020
Supply service	Food production	3351.90	2606.58	2527.26	2456.28	2564.74	2586.49
	Raw material production	2890.30	2247.62	2179.23	2118.02	2211.55	2230.30
	Water supply	6824.52	5307.04	5145.55	5001.04	5221.86	5266.13
Adjust the service	Gas regulation	9927.86	7720.33	7485.41	7275.18	7596.42	7660.82
	Climate regulation	25678.93	19969.05	19361.40	18817.64	19648.54	19815.12
	Purify the environment	11241.63	8741.98	8475.97	8237.92	8601.67	8674.59
Support services	Hydroregulation	95379.89	74171.54	71914.52	69894.82	72981.09	73599.80
	The soil remains	11128.01	8653.62	8390.30	8154.66	8514.73	8586.92
	Maintain nutrient circulation	1015.51	789.71	765.67	744.17	777.03	783.62
Cultural services	Biodiversity	10914.96	8487.95	8229.66	7998.54	8351.72	8422.52
	Aesthetic landscape	5404.22	4202.56	4074.67	3960.24	4135.11	4170.16
	Gross value	183757.7	142897.9	138549.6	134658.5	140604.4	141796.4
		3	7	3	0	7	7

### 3. Conclusions and Outlook

In the context of the economy entering the new normal, the article is based on the survey data of Beijing from 1995-2020, the value equivalence was adjusted using the ratio of the study area to the correction coefficient. The value of the ecosystem service in Beijing from 1995-2020 and the changing trend of the ecosystem service value were analyzed, the temporal and spatial changes of ecosystem service value were analyzed according with the relevant policies of Beijing in relevant years. From 1995-2010, Beijing mainly focused on the air pollution control and urban infrastructure construction. At the same time, giving consideration to the construction of ecological resources, resulting in a slight decline in the value of ecosystem services. Since 2010, the Technical Code for Ecological Environmental Status Assessment (Trial) put proposed the concept of ecological environmental quality index (EI) to quantify ecological environmental quality, we will vigorously reform the rural ecological environment to enhance the value of ecosystem services. By 2011, 113,700 mu were planted in plain area, and 1,050 mu in plain area. The ecological environment had attracted more and more attention. By 2017, Beijing proposed to adhere to problem-oriented, improving environmental quality as the core and accelerate the reform of ecological civilization system. We will improve the basic system for ecological civilization construction, and introduce the measures for Beijing Assessment. Beijing Assessment Target System of Ecological Civilization Construction, and Beijing Green Development Indicator Index System. We will make a trial compilation of natural resources balance sheets and carry out pilot audit of natural resources

assets of leading officials. Draw on the ecological protection line, controlling the important ecological space. By 2018, Beijing vigorously expand green ecological space, implement a new round of million land afforestation project, the city forest coverage reached 43.5%. by 2020, Beijing continued to promote a number of energy saving and resource utilization of efficient education practice base transformation, guide consumers to buy efficient and energy saving products, and actively create a good atmosphere for energy saving and consumption reduction. Today, the value of ecosystem services in Beijing has picked up year by year under the leadership of all the people and correct policies.

Therefore, Beijing should continue to focus on the ecological environment, value the relationship between ecological environment and people's happy life, vigorously improve the awareness of environmental protection, strengthen ecological civilization education and publicity effect. To let environmental awareness in the hearts of the people, let more people realized the value of ecological environment and the true connotation of sustainable development. Encourage the use of green energy and green materials, support the construction of green enterprises, and continue to improve the ecosystem service value evaluation system to make more accurate use of every inch of Beijing land. This work was supported in part by a grant from Research on the coordinated development of Beijing-Tianjin-Hebei ecosystem services and regional economy.

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