Land Comprehensive Value Evaluation Model

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Abstract. Lack of consideration for the cost of environmental degradation,the land value has always been assessed mistakenly. Considering both the economic gains and the environmental degradation cost, our team propose the Land Comprehensive Value Index (LCVI). Then we establish the Land Comprehensive Value Evaluation Model (LCV-EM). Firstly, we categorize the land into agricultural land (AL), industrial land (IL), public service land (PSL), and special land (SL). Then, using linear regression, we propose the contribution ratio and contribution score, and establish the regression equation of LCVI. The contribution ratio is the ratio of GDP generated by a certain type of land to total GDP; The contribution score is used to measure the integrity of the ecological service function of a certain type of land.

Keywords: environmental degradation, LCVI, contribution ratio, contribution score.

1. Introduction

Asia and the Pacific are experiencing the fastest economic growth in the world. However, current forms of economic growth have put enormous pressure on the environmental sustainability of the region. Despite the increasing environmental pressures brought about by economic growth, only through economic growth can countries in the region reduce poverty and improve environmental management. The region is in urgent need of a traditional growth that is unsustainable in the environment, the so-called “first growth, post-cleaning” model, and a new model of environmentally sustainable economic growth, the so-called “green growth” [1].

Ecosystem services are all benefits that humans derive from ecosystems. The resources needed for human survival and development are ultimately derived from natural ecosystems. However,with the continuous improvement of the productivity of human society and the continuous development of the natural environment,the natural environment has been destroyed as never before,the ecological balance has been broken,and resources have been overexploited,which will adversely affect the living environment of human beings. Such as soil erosion, land desertification, soil salinization, biodiversity reduction and so on. The consequences of environmental damage often take a long time to recover, and some are even irreversible. In order to protect the integrity and sustainability of ecosystem services. I included the impact of land use projects on ecosystem services in the development costs, estimate the overall valuation of the project and provide a direction of environmentally friendly land use projects.

2. Land Comprehensive Value Evaluation Model

2.1 Land Comprehensive Value Index

We use the comprehensive land value index (*LCVI*) as a measure of land value. The vast majority of human activity throughout history has occurred in land areas that support agriculture,habitat,and various natural resources[2]. We assume that land can be divided into agricultural landAL,industrial landIL,public service landPSL and special landSL. The contribution value of each use constitutes the *LCVI.*

2.2 Contribution Ratio

Referring to the standards of China (as the table1 shows [3]), we divide the land into four types: AL, IL, PSL and SL. AL includes cultivated land, gardens, and woodlands. IL includes land for industrial and mining storage, land for use in transportation and water, and land for water conservancy

facilities. PSL includes commercial land, public service land and residential housing. SL includes both natural and special sites.

Table 1. Classification and code of land use status

Code	Definition	type
1	Farmland	AL
2	Field	AL
3	Woodland	AL
4	Meadow	SL
5	Commercial place	PSL
6	Industrial and mining warehouse land	IL
7	Resedential land	PSL
8	Public management and public service	PSL
9	Special land use	SL
10	Land for transportation	IL
11	Land for water conservancy facilities	IL

2.3 Contribution Score

In order to comprehensively measure the cost of land degradation, based on the world bank study, we use the cost of governing each type of pollution as a share of GDP to measure land contribution scores[4,5].

x_1 :AL contribution score

x_2 :IL contribution score

x_3 :PL contribution score

x_4 :SL contribution score

Because x_4 is extremely small, to simplify the problem, we assume $x_4=0$;

z_1 :The cost of governing air pollution as a share of GDP

z_2 :The cost of governing water pollution as a share of GDP

z_3 :The cost of governing impact on the global environment as a share of GDP

z_4 :The cost of governing soil degradation and species extinction as a share of GDP

z_5 :The cost of governing coastal pollution pollution and cultural heritage as a share of GDP

z_6 :The cost of governing impact on people's health as a share as a share of GDP

The cost of governing each type of pollution in the US in 2004 is shown in table 2[5].

Table 2. The cost of curing various types of degradation

Code	Categories	Percent
1	Air	1.02
2	Water	1.07
3	Global environment	0.50
4	Land and wildlife	0.60
5	Coastal zones and cultural heritage	0.68
6	Health	0.12

We use the data in table 2 to do the principal component analysis. We do the principal component analysis. We standardize the raw data. There are six index variables for principal component analysis, namely $z1, z2, \cdots, z6$,and there are three evaluation objects. The value of the j-th index of the i-th evaluation object is aij.

Standardized indicator value $\tilde{a}_{ij}$:

$$\tilde{a}_{ij} = \frac{a_{ij} - \mu_j}{s_j}, i = 1,2,3; j = 1,2,3,4,5,6. \quad (1)$$

Standardized indicator variable $\tilde{z}_j$:

$$\tilde{z}_j = \frac{x_j - \mu_j}{s_j}, j = 1,2,3,4,5,6. \quad (2)$$

Correlation coefficient matrix $R = (r_{ij})_{6*6}$:

$$r_{ij} = \frac{\sum_{k=1}^{2} \tilde{a}_{ki} * \tilde{a}_{kj}}{2}, i, j = 1,2,3,4,5,6; r_{ii} = 1; r_{ij} = r_{ji} \quad (3)$$

r_{ij} is the correlation coefficient between the i-th indicator and the j-th indicator.

Select six principal components to calculate the contribution rate b_j:

$$b_j = \frac{\lambda_j}{\sum_{k=1}^{m} \lambda_k}, j = 1,2,3,4,5,6. \quad (4)$$

Calculate the comprehensive score X:

$$X = \sum_{j=1}^{6} b_j z_j \quad (5)$$

The calculation results are

$$x_1 = 0.4314z_1 + 0.3389z_2 - 0.0499z_3 + 0.1848z_4 + 0.7894z_5 - 0.1984z_6 \quad (6)$$

$$x_2 = 0.2717z_1 + 0.6439z_2 + 0.4879z_3 - 0.0117z_4 - 0.4557z_5 - 0.2562z_6 \quad (7)$$

$$x_3 = 0.4773z_1 + 0.0587z_2 - 0.1825z_3 - 0.7682z_4 - 0.0221z_5 + 0.3805z_6 \quad (8)$$

2.4 Land Value Regression Equation

Using a linear regression model,we can use the formula(9) to estimate the *LCVI*. This formula analyzes the environmental degradation cost of each type of land on the basis of economic analysis,and estimates the specific value of *LCVI* through the comprehensive use of land in the area. The value of *LCVI* directly represents the cost of environmental degradation and is inversely proportional to the cost of environmental degradation. When *LCVI* is positive,the cost of environmental degradation is low. When *LCVI* is negative,the cost of land degradation is high.

$$LCVI = \sum_{i=1}^{4} p_i x_i \quad (9)$$

p_1 :The contribution ratio of AL to GDP

p_2 :The contribution ratio of IL to GDP

p_3 :The contribution ratio of PSL to GDP

p_4 :The contribution ratio of SL to GDP

3. Summary

3.1 Conclusions

Considering the economic gain and the cost of environmental degradation, we propose the Land Comprehensive Value Index (*LCVI*) and establish a Land Comprehensive Value Assessment Model (LCV − EM). We propose four types of land, agricultural land AL, industrial land IL, public service land PSL, special land SL, get the contribution ratio and contribution score of various land to national/regional GDP, and obtain the regression equation of LCV - EM.

In calculating the various land contribution scores, according to UN standards, we divide environmental degradation into six categories: air pollution, water pollution, impact on the global environment, soil degradation and species extinction, coastal pollution and cultural heritage and impact on people's health.

Looking for the impact of each type of factor on various types of land, and using the principal component analysis method, we derive a comprehensive score for the three types of land in environmental degradation. Based on the contribution ratio and contribution score we obtained, we derive the regression equation for LCV - EM. We can use it to calculate the value of *LCVI*, and the value of *LCVI* directly reflects the value of land.

3.2 Advantages of the Model

i.The model is highly sensitive. Tested on different types of projects, the values of *LCVI* are quite different, and have great reference value.

ii. The model is simple and easy to understand. We divide the land use into four types, which are independent of each other. For different types of environmental pollution, we divide them into 6 categories. The rules for this division are well organized and convenient to apply.

iii. The data in the model is easy to collect. *LCVI* also reflects the role of the economy and the environment, so we use GDP as a measure of measurement, which is easy to collect and reflects the impact of economic costs on the land.

3.3 Disadvantages of the Model

i.The model cannot the calculate the contribution of SL to *LCVI*.

ii. The model does not take into account the impact of national welfare losses and does not assess the potential benefits of environmental management.

iii. Cities are increasing, but the model does not consider the impact of urbanization speed on the cost of environmental degradation.

References

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