Construction of Ecological Conservation and Assessment of Its Impact on Environment

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Abstract. The Chinese government has always been committed to implementing the strategy of sustainable development, improving the level of ecological civilization and promoting the transformation of economic and social development to all-round green growth. With the help of the Chinese government, China's Saihanba forest farm has recovered from the desert and has become an eco-friendly green farm with stable sand control function, and has begun to achieve a higher goal of ecological restoration. Saihan dam plays an important role in resisting wind and sand, protecting the environment and maintaining ecological balance and stability. By comparing and analyzing the environmental conditions before and after the restoration of Saihan dam, and building a mathematical model to evaluate the impact of Saihan dam on Beijing's ability to resist sand and dust storms, we plan to extend the ecological protection model of Saihan dam to the whole country. What geographical locations in China need to build ecological areas (quantity and scale) what is the impact on achieving China's carbon neutrality goal.

Keywords: Environment, Ecological Conservation, development.

1. Problem background and restatement

The Chinese government has always been committed to implementing the strategy of sustainable development, improving the level of ecological civilization and promoting the transformation of economic and social development to all-round green growth. With the help of the Chinese government, China's Saihanba forest farm has recovered from the desert and has become an eco-friendly green farm with stable sand control function, and has begun to achieve a higher goal of ecological restoration.

China's Saihanba ecological protection model has also set an example for the Asia Pacific region. Countries in the Asia Pacific region can also establish mathematical models to establish ecological areas (i.e.ecological protection areas) and evaluate their impact on absorbing greenhouse gases and reducing carbon emissions.

Based on the above background, the following questions were answered on the basis of collecting the ecological environment of Saihanba forest farm, Beijing and the whole country and the relevant data of a country in the Asia Pacific region:

China's Saihanba ecological protection model has made an example for the Asia-Pacific region. Please choose another country from the Asia-Pacific region to establish a mathematical model and collect relevant data, and then discuss which geographical locations in this country need to build an ecological area (ie.Ecological Reservation), as well as determine the number or scale of ecological areas to be built; moreover, to evaluate its impact on absorbing greenhouse gases and mitigating carbon emissions. Please write a non-technical report to the Asia-Pacific Mathematical Contest in Modeling Organizing Committee (APMCM), describing your models, and proposing feasible plans and suggestions for building ecological reservation.

2. Problem analysis

2.1. Problem one analysis

First, the analysis of Saihanba here is actually a comparative analysis of the woodland planting situation of Saihanba in recent years and the resulting environmental changes, and the most key index is the forest coverage rate of Saihanba over the years, forest area, forest savings, types of trees and so on. These data are all included in the environmental evaluation system of the forest, so the processing needs to be combined with the above data and other supplementary data for processing and integration.

Finally, predicting economic indicators based on historical data alone cannot accurately reflect the specific impact of environmental changes. In order to calculate the predictive value of the environmental index through the predictive value of the principal component index, you need to find the relationship between the environmental index and the principal component. In this paper, we analyze the future predictive relationship on the time span based on the Z-Score model. The predictive value of the principal component index is replaced into the model to obtain the predictive value of the environmental index, and then analyze the future development situation of Saihanba.

2.2. Problem two analysis

For evaluation models, hierarchical analysis, gray correlation analysis, principal component analysis, factor analysis, DEA data envelope analysis and so on were processed and analyzed.

Finally using TOPSIS algorithm modeling, by using Z-Score standardization method, weight allocation, screening out the following indicators, the number of automatic meteorological stations, annual average precipitation, annual wind days, forest coverage rate, using the TOPSIS algorithm, calculate the annual comprehensive ecological score, through detailed analysis of its score data, Beijing by the environmental changes.

2.3. Problem three analysis

Problem 3 is also problems related to geographical analysis. Multiple ecological areas mainly refer to areas where the ecological environment is relatively deteriorating, and relevant indicators need to be selected (expand the scope of indicators, such as factory density, water pollution index, population, land size, and the relevant indicators of forest cities.) Ecological data were evaluated for each region. Establish a mathematical model of a comprehensive ecological environment evaluation system, determine the number and scale of China needs to establish ecological reserves, and assess the impact on carbon neutral comprehensive targets.

2.4. Problem four analysis

The fourth question is to build a mathematical model from the Asia Pacific region and collect data, then discuss which geographical location in the country (and determine the number or scale of the ecological protection areas to be built; to evaluate the impact on greenhouse gas absorption and reducing carbon emissions, which can be analyzed directly after the third question. By comparing the comprehensive data indicators of the countries, we collected some countries in nearly 14 years, and selected Mongolia for data processing.

3. Modeling and solution of problem one

Today, the forest coverage rate of Saihanba area has reached 80%.Every year, Beijing and Tianjin provide 137 million cubic meters of clean water purification, fixing 747,000 tons of carbon, and releasing 545,000 tons of oxygen. After more than half a century of struggle, the world's largest plantation was built on the land of Saihanba. Builders have expanded afforestation by 1.12 million mu and planted more than 400 million trees on the plateau wasteland, 400 kilometers north of Beijing. On the one hand, it has the historical mission of "civilized development and ecological prosperity". On the other hand, new problems have also been encountered on the road of green development. So, the Saihanba people now have a higher goal, that is, to restore the ecology. Since the 18th CPC National Congress, three major projects have been launched: afforestation, natural improvement of artificial forests, and near-natural cultivation of natural forests.

Select appropriate indicators to collect relevant data, establish an evaluation model of the impact of Saihanba on the ecological environment, quantitatively evaluate the environmental impact of

Saihanba after the restoration, and compare and analyze the environmental conditions before and after the recovery of Saihanba. The analysis of Saihanba here is actually a comparative analysis of the woodland planting situation of Saihanba in recent years and the environmental changes of the environment, and the most critical index is the forest coverage rate of Saihanba over the years, forest area, forest savings, types of trees and so on. These data are all included in the environmental evaluation system of the forest, so the processing needs to be combined with the above data and other supplementary data for processing and integration.

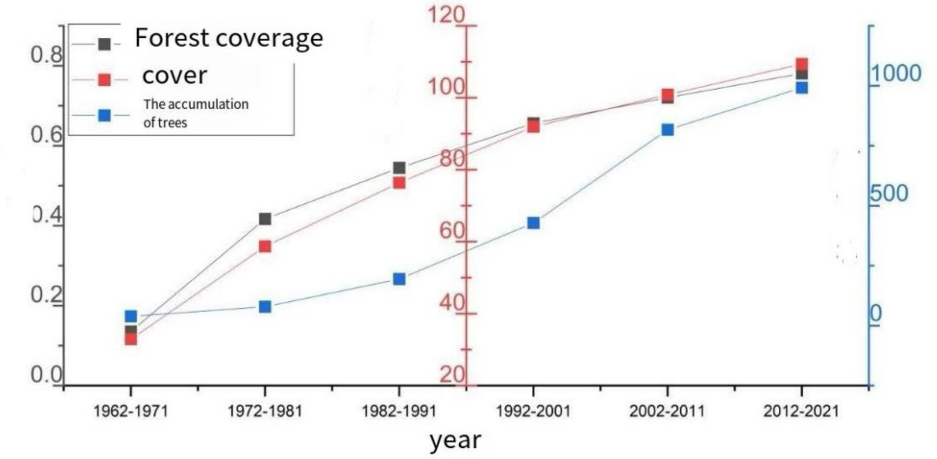

Figure 1 Analysis of forest coverage index

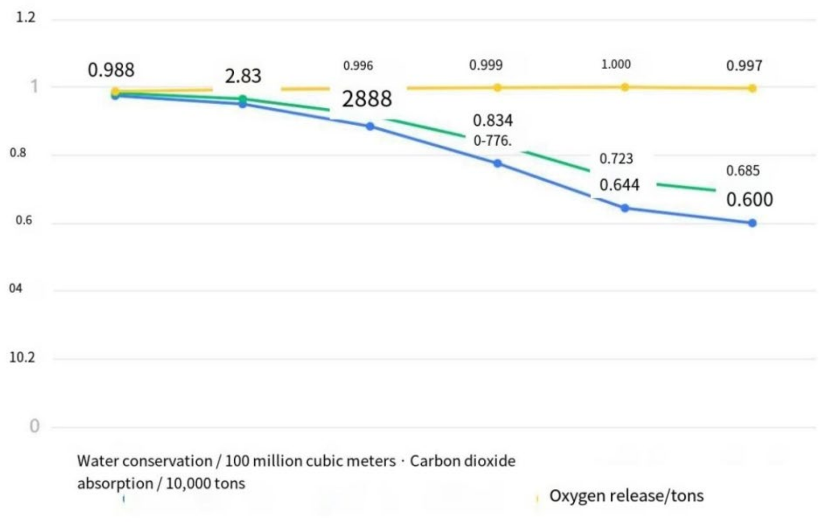

Figure 2 Line chart of important indicators of local ecological data

Table 1 Analysis of Saihanba restoration index

a particular year	land area covered with trees	Coverage area / ten thousand mu	Forest stock / 10,000 cubic meters	Tree stock / ten thousand cubic meters of _Z standardization (S)	Coverage area / ten thousand mu _Z standardization (S)
1962-1971	13.57142857	32.93101482	39.23588106	-0.966059874	-1.584949275
1972-1981	41.68187183	58.69315673	78.84308395	-0.866862691	-0.686547373
1982-1991	54.48201558	76.38432048	194.3815946	-0.577493742	-0.069604293
1992-2001	65.61933492	91.97484483	428.1401192	0.007960046	0.474083292
2002-2011	72.06037288	100.8904669	817.1913291	0.982348061	0.784997341
2012-2021	78.09789663	109.407755	991.9791028	1.4201082	1.082020309

a particular year	Forest Coverage _Z Standardization (S)	Refer to association variables	Water conservation / 100 million cubic meters	CO 2 absorption / ten thousand tons	Oxygen release amount / ten thousand tons
1962-1971	-1.710557717	-1.420522289	0.108	3.255654753	2.264540049
1972-1981	-0.528559711	-0.693989925	0.200672486	6.542120479	4.550511327
1982-1991	0.009665327	-0.212477569	0.322684002	16.12909779	11.21893771
1992-2001	0.477971328	0.320004889	0.501041321	35.52555407	24.71055626
2002-2011	0.748806404	0.838717268	0.815977083	67.80764858	47.16505511
2012-2021	1.002674369	1.168267626	1.602427825	82.31092035	57.25311489

Due to the large time span, the data differences between years are large and difficult to handle. In order to facilitate observation and statistics, the year is divided into six equal parts, so that the growth rate and change trend of the data are more intuitive. At the same time, the geometric average algorithm is used to average the forest coverage rate, whose value is relatively stable, which makes the original discrete data tend to average. Even if the data sampled over the years is slightly biased, it will not affect the overall trend, and the sampling is representative, making the rate of change more intuitive. Because the change of forest coverage area and other data within 10 years is not large, and there is no extreme data situation, the arithmetic average algorithm is used to average to reduce the error.

4. Modeling and solution of problem two

Problem 2, it is necessary to establish a mathematical model to evaluate the impact of Saihanba on dust resistance in Beijing. To quantitatively analyze the recovery of Saihanba Forest Farm plays an important role in Beijing by selecting appropriate indicators and relevant data to resist dust storms. Unlike Question 1, in Question 2, the dust sandstorm is mainly considered, but also from analyzing the direct impact of local environmental transformation to analyzing the indirect impact on the surrounding areas.

Therefore, in Question 2, relevant ecological and environmental indicators (dust storms) and relevant influencing factors should be selected to describe the impact of the environmental transformation of Saihanba area on the ecological environment of Beijing. First, the factors affecting the formation of dust storms, one is to reclaim forestry land to destroy the original ecological environment; the second is the grassland degradation caused by excessive grazing; the third is deforestation, leading to the loss of forest resources; the fourth is the abuse of water resources, leading to soil and soil erosion. The formation conditions of sand storms need to be considered here, including strong wind, dust, dry, air state, etc.

Table 2 Carbon emission data of Beijing Municipality

a particular year	CO2	a particular year	CO2	a particular year	CO2
1997	42.4557653	2004	60.10823242	2011	80.72415861
1998	41.56767913	2005	67.06433445	2012	83.3736003
1999	42.94938984	2006	74.79318071	2013	66.50234372
2000	45.52773703	2007	76.54082105	2014	67.65940598
2001	44.12167439	2008	78.23019967	2015	63.59033977
2002	48.12877021	2009	86.42823789	2016	67.41650886
2003	55.15573473	2010	90.90722066	2017	60.0864323

Air quality is an important indicator to reflect the local ecological quality and an important factor to measure the dust storms.The monthly AQI was calculated by bringing the monthly PM2.5, PM10, CO, C O, NO_2, SO_2 and O_3 from 2014 to 2019) to the AQI calculation formula. The AQI data were averaged in months and integrated to get the average AQI per year. The change trend and relative change percentage of this data were processed and analyzed to obtain the air quality improvement in Beijing.

Finally using TOPSIS algorithm modeling, by using Z-Score standardization method, weight allocation, screening out the following indicators, the number of automatic meteorological stations, annual average precipitation, annual wind days, forest coverage rate, using the TOPSIS algorithm, calculate the annual comprehensive ecological score, through detailed analysis of its score data, Beijing by the environmental changes.

Based on the dimensionality reduction data, we calculated the final annual integrated ecological score using the topsis method. First of all, the four main components of environmental protection and sand resistance: the number of automatic meteorological stations, annual average precipitation, annual number of strong wind days, and forest coverage rate are standardized.

5. Modeling and solution of problem three

Determine which geographical locations in China need to build ecological areas (i. e., ecological protection areas).The per capita water resources, wetland area ratio, forest area ratio, grassland area ratio, number of nature reserves, nature reserve area, waste fixation (emission ratio), waste gas (PM2.5 concentration), waste liquid (discharge) and other relevant indicators are selected.

After using the hierarchical analysis method and performing the consistency test of the data, the TOPSIS evaluation model is used to establish the evaluation model, use the TOPSIS algorithm to obtain the ecological score index of each province, and then rank by score. Finally, the three provinces with the lowest score were selected to build the ecological protection areas.

The principle of hierarchical analysis, according to the nature of the problem and the overall goal to be achieved, the problem into different components, and membership according to different levels, form a multi-level analysis structure model, and finally make the problem down to the lowest layer (decision scheme, measures, etc.) relative to the relative important weights of the highest level (overall target) arrangement.

According to the land planning of the local governments in Shanxi, Hebei and Anhui provinces, combined with the local natural and geographical conditions and ecological conditions, as well as the funds spent in building the ecological zone, to determine the scale of the ecological zone that needs to be built. At the same time, according to the geographical location of the three provinces and the environmental resources of different regions, the role of ecological reserves can be determined to play the largest geographical location.

6. Modeling and solution of problem four

The fourth question is to build a mathematical model from the Asia Pacific region and collect data, then discuss which geographical location in the country (and determine the number or scale of the ecological protection areas to be built; to evaluate the impact on greenhouse gas absorption and reducing carbon emissions, which can be analyzed directly after the third question. By comparing the comprehensive data indicators of the countries, we collected some countries in nearly 14 years, and selected Mongolia for data processing.

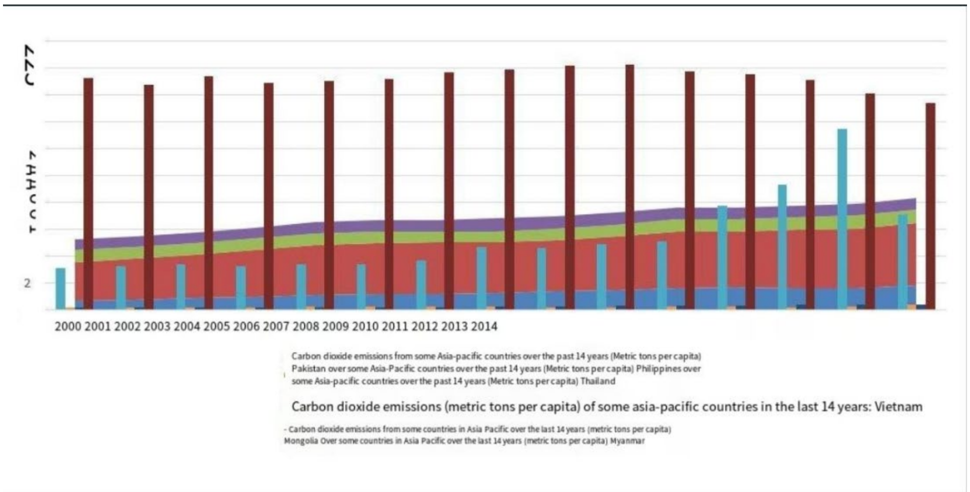

Figure 3 CO_2 emissions from the Asia-Pacific countries

The purpose of the consistency test is to compare the results obtained by different methods are consistency. There are many methods to test the consistency, such as: the Kappa-test, the correlation coefficient within the ICC group, the Kendall W coordination coefficient, etc. Here we adopt the Kendall W coordination coefficient, which is the method of analyzing the correlation between multiple data, suitable for quantitative data, especially theorder-rank data. The data were computationally collated using the raw data and the SPSSAU.

7. Modeling and solution of problem five

For the first question, determine which geographical locations in China need to build ecological areas (i. e., ecological protection areas).Select per capita water resources, wetland area ratio, forest area ratio, grassland area ratio, nature reserves, nature reserve area, waste solid (emission ratio), waste gas (PM2.5 concentration), waste (discharge), conduct consistency test of data using hierarchical analysis method, use TOPSIS evaluation model, use the ecological algorithm, and then sort by the score. Finally, the three provinces with the lowest score were selected to build the ecological protection areas.

The fourth question is to build a mathematical model from the Asia Pacific region and collect data, then discuss which geographical location in the country (and determine the number or scale of the ecological protection areas to be built; to evaluate the impact on greenhouse gas absorption and reducing carbon emissions, which can be analyzed directly after the third question. By comparing the comprehensive data indicators of the countries, we collected some countries in nearly 14 years, and selected Mongolia for data processing.

Through the above data analysis, we conclude that the establishment of nature reserve is the way for human beings to conduct ecological ethics fromthe perspective of nature. Only from "man" and "nature" can the problem of "man and nature" solve most completely.

Since the establishment of the first nature reserve in 1956, the type of reserves has been from single to comprehensive, from scratch. The area is from small to large, which has basically formed a nature reserve system with relatively complete types, basically reasonable layout and relatively perfect functions.

Based on nature reserves, it will be a national park by integrating multiple nature protected areas in the same area in the future. Nature reserves incorporated in the national parks will be managed according to the design concept of the national parks.

8. Model promotion

8.1 Model strength

Considering the different conditions of the ecological environment in the different regions, we comprehensively analyzed the direct and indirect effects of the different indicators on the environment. Furthermore, the predictive of the strategy was compared and validated by various data.

This paper not only conducts a quantitative analysis of the problem, but also combines a reasonable qualitative analysis to improve the main logic of the paper. Moreover, to improve the accuracy of the problem, the algorithm is compared and analyzed, thus improving the overall computational accuracy of the problem.

makes full use of data visualization technology and uses graphical visualization methods to make the data display more intuitive and efficient.

8.2 Model weakness

Due to time constraints, data characteristics and related metrics cannot be fully mined, and the accuracy of the model needs to be further improved. This can also serve as the next step in this paper;

Although we have quantified some uncertainties, the actual policy simulations are still a very complex system that can be further improved and analyzed in future studies.

Reference

[1] Weiqiang Chang ,Dynamic change analysis of forest resources in Saihanba mechanical Forest Farm ,2018.
[2] Lei Yu,On the investigation and design of forest resources in Saihanba Forest Farm ,2021.
[3] Guoqing Sun,Ecological protection and restoration of Saihanba Forest Farm ,2021.
[4] Qianyu Zhu , Design and implementation of forest resources data visualization system in Saihanba Forest Farm ,2019.
[5] Qun Hu.The impact of Sino-US trade conflicts on China's economy under the Trump's administration[D].Foreign Economic and Trade University, 2019.
[6] Yunlin Zhang , Study on the value of forest ecosystem service function in Saihanba Nature Reserve ,2012.
[7] Jianjun Wang,Study on plant diversity and 3S aided analysis technology in Saihanba Nature Reserve,2004.
[8] Li Shuyan, Ma Jingjin, Xuan Chunyi, Analysis of extreme weather events in Beijing during 1951-2008[J].Climatic and Environmental Research(in Chinese),2011.
[9] Minrui Fan,Response of net primary productivity of forest ecosystem to climate change in mountainous areas of Beijing,2011.
[10] Chao Li,Temporal and spatial model of vegetation ecological quality in China and its response to climate change ,2021.
[11] Wenxiang Cai,Trend characteristics and extreme value distribution of extreme climate events in China,2016.
[12] Jinzhu Wang,Yanping Liu,Discussion on the evaluation of regional water resources richness,2015.