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Assessment System of Natural Environment Protection Based on Energy Efficiency

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Abstract: Since the reform and opening up, China's economy has developed at a rapid pace, and the impact of industrial development and social change on the natural environment has become more diverse and profound. In evaluating the economic value of nature reserves, we often have to consider their current economic value, and past values appear to be meaningless, which makes it necessary to ensure both a reliable basis for the calculation criteria when calculating the value of reserves, and the use of time-recent This makes it necessary to ensure that the criteria for calculating the value of protected areas are reliable and that the most recent data are used. Therefore, this paper uses Nature Reserve C as an example to construct an assessment system for natural environment protection based on energy efficiency. The paper begins with a brief introduction of the evaluation principles and the carbon balance evaluation model, followed by the design of the nature reserve evaluation system and the general architecture of the system, and finally the analysis of the natural resource value and the economic value of the nature reserve.

1. Introduction

Dealing with ecological environmental protection and economic development of ecological values has practical significance for the sustainable development of nature reserves [1]. The protection and evaluation of ecological assets in nature reserves is not only the basis for ensuring the long-term survival of human beings, but also a key issue that needs to be urgently addressed in the process of sustainable development of regional economy and society [2-3]. In the current studies on the valuation of ecological assets in nature reserves, people do not have a comprehensive understanding of ecological assets, and some studies only estimate the value of ecosystem services ignoring the importance of natural resource stocks; they lack studies on the estimation of their dynamic value for improving the environmental service functions of protected areas and surrounding communities [4-5]. When conducting ecosystem valuation, due attention should also be paid to the scope and context of each valuation indicator [6].

With the increasing prominence of environmental pollution problems, a large number of experts and scholars have conducted research on natural environmental protection systems with good results [7]. For example, Abdolreza Azadmanesh et al. chose the meta-heuristic algorithm Particle Swarm Optimisation (PSO) to solve the optimal selection problem for natural protected areas, converting the real domain equations of the PSO algorithm into binary results compatible with the OSRN problem, and testing results showed that two of the four transfer functions derived were suitable for solving the optimal selection problem for natural protected areas [8]. Abdulrahman Khamaj is investigating whether these health restoration effects can be reproduced in a simulated environment, offering new possibilities for preventive care and treatment, and empirical studies using virtual nature for restoration have been analysed descriptively, exploring commonalities and differences between studies and highlighting measured outcomes and patterns [9]. The construction of a nature reserve assessment system is conducive to the healthy development of ecosystems.

A scientific and efficient assessment of the dynamics of ecosystem service functions and their values in nature reserves can provide important support for forest restoration as well as ecological compensation [10]. Therefore, this paper discusses the assessment system of nature conservation based on energy efficiency. This paper is divided into three parts: the first part is an overview, including the evaluation principles and the carbon balance evaluation model; the second part is the construction of the environmental assessment system of nature reserves, including the evaluation system of nature reserves and the overall architecture design of the system; the third part is the analysis of the value of nature reserves, including the analysis of natural resource value and economic value. The third part is the analysis of the value of nature reserves, including the analysis of natural resource value and economic value.

2. Relevant Overview

2.1. Evaluation Principles

A good start for evaluation lies in the unified principles of evaluation, which are the basic guidelines for establishing an indicator system that can be applied to the majority of nature reserves evaluated [11-12].

(1) Principle of objectivity.

To conduct a comprehensive evaluation of nature reserves, objectivity is the premise of the study, and is an important basis for fully understanding the actual situation in the study area and making an objective assessment and identification of the research object [13].

(2) Principle of scientificity.

In order to guarantee the objectivity and reasonableness of the evaluation results and truly reflect the development level and problems of the nature reserve, the scientific nature of the evaluation index system is particularly important, and should follow the basic principles of landscape ecology theory, priority protection theory and sustainable development theory [14].

(3) Principle of hierarchy.

The nature reserve is an organic whole that is developed in a unified manner, with many influencing factors. When establishing the evaluation index system, each influence factor should be refined from top to bottom, so as to clearly and reasonably reveal the actual situation of the study area[15].

(4) The principle of dynamic development.

Nature reserves are changing and developing, and the evaluation index system should fully reflect the real status quo of nature reserves, and also take into account the dynamic nature of development and the stability of data, in order to accurately evaluate the current status of the development of nature reserves and predict their future change trends[16].

2.2. Carbon Revenue and Expenditure Evaluation Model

Tourism ecosystem is a complex ecosystem that integrates tourism resources, natural resources, social and economic factors, and is also a dissipative structure in which carbon emissions and carbon absorption act at the same time. Scientific assessment of the carbon footprint of tourism activities and the carbon absorption of natural ecosystems, i.e. the carbon balance of tourism ecosystems, is important for the quantitative analysis of the carbon balance of tourism activities and the formulation of low carbon management decisions in nature reserves [17-18].

$$W = P / R \tag{1}$$

$$K = R - P \tag{2}$$

In equations (1) and (2), W denotes the carbon balance coefficient of the tourism ecosystem; K denotes the net carbon sink, kg; the meaning of P and R is the same as above. When W>1, or K<0, it means that the carbon source of the tourism ecosystem is greater than the carbon sink; when W<1, or K>0, it means that the carbon source of the tourism ecosystem is less than the carbon sink; when W=1, or K=0, it means that the carbon source and carbon sink of the tourism ecosystem are equal, i.e. the carbon balance.

3. Construction of the Evaluation System

3.1. Nature Reserve Evaluation System

The theoretical model of the nature reserve evaluation system involves a large number of data operations and data collation processes. The use of Web technology can concretize, automate and network this theoretical model, and the flow chart of the nature reserve evaluation system is shown in Figure 1.

(1) Improving evaluation accuracy. In the traditional evaluation system, errors may occur in the processes of data entry, data collation, data arithmetic and data preservation. The Web-based evaluation system automates the entire process, with its data directly stored in the database, the data processing core calling data from the database, and the results being stored in the database, without the need for operators to collect and collate data, enter data into the relevant software, or edit arithmetic rules throughout the process, eliminating the errors that may occur in the manual process.

(2) Improved evaluation speed. The evaluation model requires a large amount of data to be entered into the matrix, which can take a lot of time if entered manually, and if software is used for the calculation, process control is required, and some software needs to be written in code, which takes more time. However, for the system designed in this paper, the process of data collection, collation, entry and code writing is completely eliminated.

(3) Cost saving. The system designed in this paper is based on a B/S mechanism where all processes are carried out on the Internet, the expert is provided with an access link to an online questionnaire, and the data submitted after the evaluation is completed is instantly deposited into the database, incurring almost no marginal costs. The system can therefore be described as an online, automated evaluation system based on a theoretical model, capable of outputting results, and the system evaluation process is shown in Figure 1.

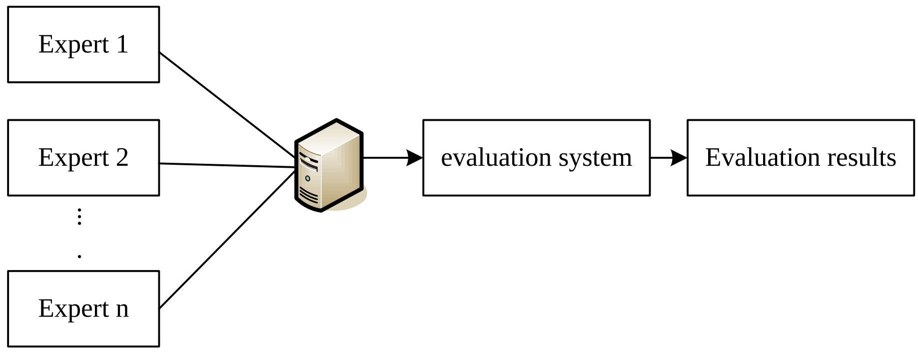

Figure 1. Flow chart of the nature reserve evaluation system

3.2. Overall System Architecture

After determining the corresponding requirements through the system requirements analysis and defining the system design principles, the overall architecture is designed as shown in Figure 2.

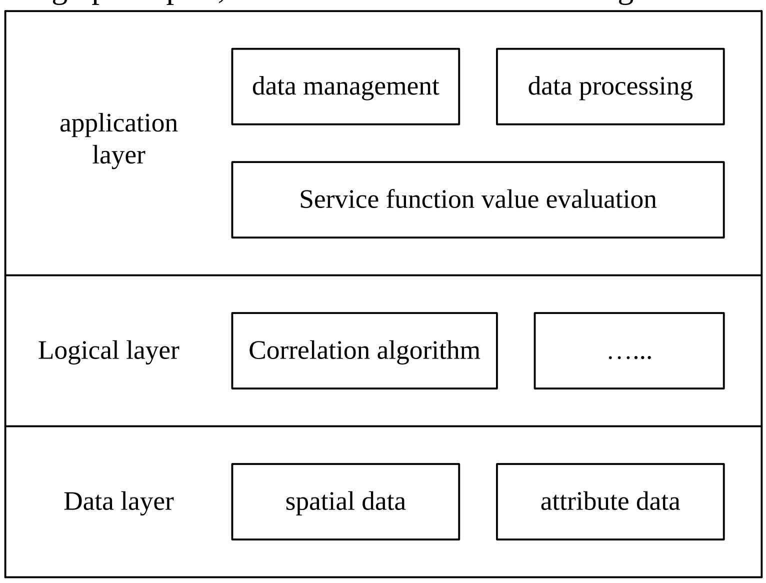

Figure 2. Overall architecture of the evaluation system

(1) Data layer: The data layer is the underlying architecture, providing the system with basic data support, specifically including spatial data such as vector data (forest phase map) and raster data (vegetation cover, evapotranspiration data, rainfall data, etc.), as well as attribute data (e.g. biomass model, soil capacity, species data, etc.) stored in the form of EXCEL.

(2) Logic layer: The logic layer is the core part of the three-layer architecture and uses relevant algorithms to realise the process of processing the input data in order to obtain the required calculation results.

(3) Application layer: The application layer is the top-level architecture directly facing the user, and the user operates through various functional modules. By inputting the relevant data required to run the function modules, basic functions such as data management, data processing and attribute query can be realised, as well as advanced functions such as landscape pattern calculation, restoration measure layout and service function value assessment.

4. Value Analysis

4.1. Analysis of Natural Resource Values

The forest ecosystem, as the main body of the C nature reserve, accounts for 82% of the entire nature reserve. Forests in the nature reserve are not allowed to be exploited for logging, and the value of forest ecosystem resources will be valued by the value of live wood accumulation instead. The total existing standing timber stock in the reserve is approximately 5.47 million m3, and the value of forest resources is RMB 518,706,000 based on a price of RMB 930 per cubic metre of logs on the economic market in 2022. In order to solve the problem of high value, a correction was made from the perspective of unit area volume and value volume, and the average value of forest ecosystem unit area was 2.45 million yuan/km-2, resulting in a forest resource value of 386,358.7 million yuan. Yuan. The final value of forest resources in Nature Reserve C is RMB 4525,346,500, based on the average value of the two, and Nature Reserve C has very high biomass, richness and vegetation cover, and the amount of grassland resources is very different from that of woodland resources. In comparison, the area of typical meadow ecosystems is small, so in this study, scrub, meadow and alpine tundra vegetation are grouped into this category, with a total area of 7,684hm2. The average value per unit area of grassland ecosystems is 170,000 yuan/km-2, and the estimated value of grassland resources in Nature Reserve C is about 130,628,000 yuan. The total value of water resources can be calculated to be RMB 5,540,900,000, based on the quality of existing water resources combined with the value of a unit of cubic metre of water. The average value per unit area of water ecosystem is RMB 580,000km2, which gives a water resource value of RMB 566,393,200 for Nature Reserve C. The average value of water resources for Nature Reserve C is RMB 509,865,900.

Table 1. Natural resource value assessment results

	Area(hm$^{2)}$	Physical value
Forest resource value	157697.42	452534.65
Grassland resource value	7684	1306.28
Water resource value	976.54	56024.16
total	166357.96	509865.09

4.2. Economic Value Analysis

In this paper, the value of C Nature Reserve is divided into direct and indirect values, where the direct and indirect values include the value of woodland resources and forest resources respectively, and the indirect and indirect values take into account the value brought by the different ecosystem service functions of C Nature Reserve, which include connoting drinking water sources, maintaining land, sequestering carbon and releasing oxygen, purifying the environment, maintaining natural biodiversity, etc. The values of the C Nature Reserve are shown in Table 2. The direct values are shown in Table 2 and the indirect values are shown in Figure 3.

As shown in Figure 3, the direct value of Nature Reserve C is divided into the value of woodland resources and the value of woodland assets, and the above calculation shows that the value of woodland resources is less than the value of woodland assets. Overall, the direct value of C National Nature Reserve increased from RMB 33,158,200 in 2012 to RMB 96,199,500 in 2017, an increase of RMB 63,041,300, with a growth rate of 190.12%, and the direct value in 2022 was RMB 150,425,300, an increase of RMB 75,239,400 over 2017, with a slower growth rate of 78.21%. The total increase in direct value from 2012 to 2022 is $117,267,100 with a growth rate of

353.66%. This represents a more than threefold increase in direct value in just 10 years, which shows that forest resources contain huge economic wealth and that their value is growing positively. This indicates that the value of forest resources is increasing as the country becomes more conscious of ecological protection and the price of forest trees in the market rises.The rapid increase in the price of forest assets in nature reserves is not only closely related to the price level, but also to the standard of living. There is a correlation between the rise in

Table 2. Direct value dynamics

	2012	2017	2022
Forest land value	439.37	1965.83	5387.64
Forest value	2876.45	7654.21	9654.89
Direct value	3315.82	9619.95	15042.53

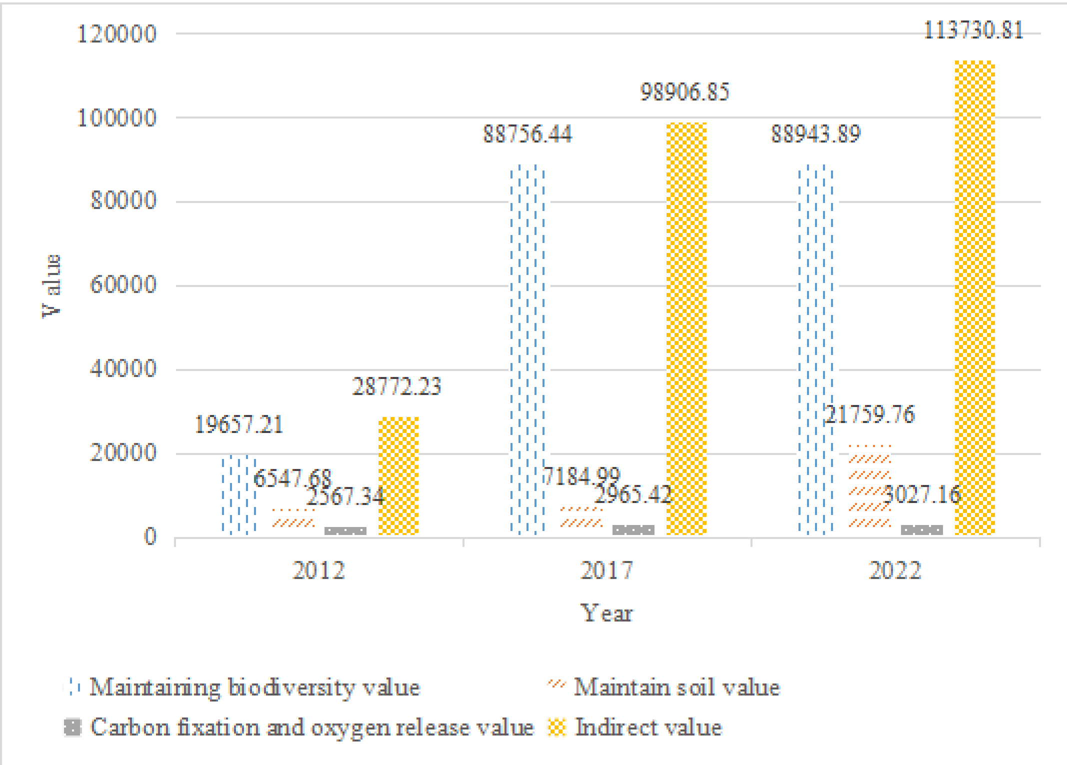

Figure 3. Dynamic changes in indirect value

As shown in Figure 3, the amount of indirect value of Nature Reserve C is generally on an upward trend, and the amount of indirect value in 2012, 2017 and 2022 is RMB 287,722,300, RMB 989,068,500 and RMB 113,730,800 respectively, with a significant increase. Comparing the changes in the growth rate of the value of different ecological services in different years, the following conclusions can be drawn: the value of maintaining biodiversity in nature reserves has grown the fastest in recent years, from RMB196,572,100 in 2012 to RMB889,438,900 in 2022, an increase of nearly 3.52 times in the last ten years. The value of soil conservation has increased the second most, from RMB 65,476,800 in 2012 to RMB 217,597,600 in 2022, an increase of nearly 3.22 times in the last ten years. In terms of carbon sequestration and oxygen release, the change in value was less dramatic, but the increase in total indirect value led to a decrease in its share. This is because grassland has the most prominent economic value in terms of carbon sequestration and deoxygenation, and the value of its carbon sequestration and oxygen release function decreases as the area of grassland slightly decreases with the increase of other forest division resources in the reserve year by year.

5. Conclusion

Forests have a variety of ecosystem services such as water conservation, carbon sequestration and oxygen release, and species conservation, which play an important role in supporting human survival and development. Therefore, this paper constructs an assessment system for natural environment protection based on energy efficiency. The analysis of the natural resource value of forest ecosystems in Nature Reserve C reveals that the value of water resources in Nature Reserve C turns out to be 509,865.09 million yuan. The analysis of the direct and indirect values of the C nature reserve found that both the direct and indirect values of the C nature reserve showed an increasing trend. Due to the limited time available in this paper, there are many areas that need to be improved in the article.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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