SYLWAN 167 (9): 583-605, September 2023
https://doi.org/10.26202/sylwan.2023034
Journal homepage: https://sylwan-journal.pl

ORIGINAL PAPER

The improvement of a forest resource valuation system – a case study of Beijing, China

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ABSTRACT

Forest resources play a pivotal role in addressing the pressing challenges of climate change mitigation and biodiversity conservation. The accurate valuation of forest resource assets is a foundational element in the scientifically sound pricing of natural resources. Moreover, it serves as a critical step in realizing the true value of forest ecological products, offering insights into the impact of human activities on these invaluable resources. As a key aspect of the environment, forest is closely related to ecological security and sustainable development, which underscores the importance of forests in providing essential ecosystem services. To accurately assess the value of forest resource assets, herein we present a forest resource asset value accounting system using Beijing, China, as a case study. First, limitations of current forest resource asset accounting practices used in China and abroad and directions for improvement are discussed. The significance of a well-rounded approach becomes evident, one that encompasses various perspectives and dimensions of forest resources, thus ensuring a more holistic valuation. Next, considering the unique characteristics of Beijing's forest resources, including abundant protected forests, forests for special purposes, plantation forests, juvenile/middle-aged forests, and many old and valuable trees, we establish an index system for forest resource asset value accounting in Beijing. We include economic and ecological value in our index system by using the systematic analysis method, literature research method, and comparative research method. This index system covers 13 asset accounting indicators and 33 specific accounting indicators. Finally, we delve into the distinctive features and practical applications of the Beijing forest resource valuation system. This research holds the potential to offer more than just theoretical insights into the utilization of forest resources and the valuation of forest resource assets in Beijing. It can also act as a benchmark for evaluating forest resources in cities across China and various nations with comparable ecosystems.

KEY WORDS

Beijing, ecological product value, forest resource assets, value accounting, value application

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Received: 7 July 2023; Revised: 8 November 2023; Accepted: 21 November 2023; Available online: 20 December 2023

Introduction

Forest resource asset value accounting meets diverse societal needs by reflecting changes in forest resource assets and the comprehensive ecological, social, and cultural benefits of forestry (European Communities, 2002; Liu *et al.*, 2015; Fan *et al.*, 2016). It also incorporates the economic contribution of forest resources into the national economic accounting system and presents the contribution of forest products and services to national and regional economic development using a visual approach.

There are many precedents and typical cases of ecological asset assessment worldwide. International natural resource accounting is mainly reflected in macro-environmental economic accounting. Its landmark achievement is the *Environmental Economic Integrated Accounting System 2012 – Central Framework* (SEEA), issued by the United Nations and other organizations (Yang *et al.*, 2013; Geng *et al.*, 2015), which provides a basic framework and technical guidance for natural resource and environmental and economic accounting. Many countries and regions have adopted this system and explored their own environmental and economic accounting systems. Notable examples include Norway (Longva *et al.*, 1981; Alfsen *et al.*, 1987), the Netherlands (Statistics Netherlands, 2014), Canada (Statistics Canada, 2006), Australia (van Dijk *et al.*, 2014) and the United Kingdom (Office for National Statistics, 2019, 2020). China's research on the establishment of matching natural resource assets accounting with national economic accounting started late. This delay has afforded the absence of a unified system for accounting natural resource assets and a consistent framework for accounting forest resource assets in China.

In 2009, Beijing formulated the *Specification for Valuation of Forest Resource Assets* (DB11/T 659-2009) (Beijing Municipal Bureau of Quality and Technical Supervision, 2009), which specifies the accounting process, accounting index system, physical stock accounting method, value accounting method, and data sources for forest resource assets. However, this specification does not include accounting for old and ancient tree assets and cultural forest assets. Beijing revised the specification in 2018, adding three accounting indicators in the new version (DB11/T 659--2018): humidity improvement, temperature reduction, and PM2.5 reduction. However, the revised version still lacks characteristics and relevance in the selection of indicators and does not fully reflect Beijing's forest resource attributes and accounting objectives. The calculation method for each indicator in the specification is relatively simple, such as using the product of forest area and annual rent per unit area of forest land as the result of forest land asset accounting, without full consideration of the nature and characteristics of different types of forest land.

As we delve into the research and practices of both typical countries and China, several insights emerge. First, there is an urgent need to provide a clear and precise definition for natural forest resource assets. Currently, the research lacks a standardized definition, causing vagueness in the interpretation of forest resource assets and their connotations. Researchers often rely on systems established by the United Nations and their respective countries, adapting them to their specific research objectives and requirements (Feng, 2009). These modifications complicate horizontal comparisons among different regions (Chen, 2020). Second, a clear distinction needs to be made between stocks and flows. The value accounting of forest resource assets covers both asset value and production value (*i.e.*, ecosystem service value), with the former being a stock analysis and the latter being a flow analysis. The forest resource asset valuation should consider these two aspects. Third, it is essential to continuously enhance the precision and validity of accounting results. The selection of technical methods should be guided using the diverse values of forest resource assets and taking into account the unique characteristics of the study area. Forestry, vital for Beijing's environment and sustainability, affects ecological security and economic growth. Forest resource asset valuation is essential for harnessing natural resources, realizing ecological product value, and setting ecological compensation standards. Our research aims to evaluate Beijing's forest resource asset value using internationally recognized evaluation methods, enhancing the accounting system.

Materials and methods

STUDY AREA. Beijing (39°28'~41°05'N, 115°25'~117°30'E), located in the northern part of the North China Plain, covers a total land area of 16,410.54 km^2 (Meng, 2011). Its predominant vegetation is warm temperate deciduous broad-leaved forest. Forest resource distribution in the area is uneven, with rich resources in the northwest mountainous region and relative scarcity in the urban plain region. As of the end of 2021, the city's forest area encompassed 852,700 hectares, with a forest coverage rate of 44.60% and total growing stock of 38,299,500 m^3. Forest vegetation's overall biomass measures 53.5311 million tons, and the total carbon storage amounts to 25.8398 million tons (Chen, 2020).

Beijing forests have some distinct features: First, there is a significant amount of ecological public welfare forests with substantial ecological asset value (Fig. 1). Second, Beijing boasts a significant proportion of juvenile/middle-aged and plantation forests with substantial carbon sequestration potential (Fig. 2 and 3). Third, Beijing has a wealth of ancient trees with significant historical and cultural value. The city is home to over 30,000 second-class protected ancient trees aged over 300 years and more than 5,000 first-class protected ancient trees aged over 500 years. Furthermore, since 2013, Beijing has hosted ten consecutive Forest Culture Festivals, with over 20 forest parks in the city organizing more than 500 forest culture activities.

METHODS. In this study, we refer to the systems analysis method as guidance, using the literature research and comparative study methods to establish the Beijing forest resource asset value accounting system. We selected the index of forest resource asset value accounting based on China's conditions, international experiences, and the latest research. Additionally, we pinpoint

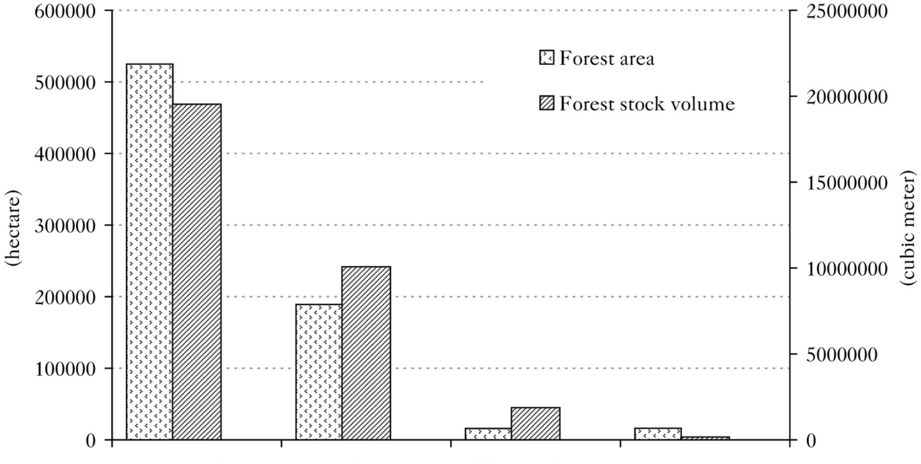

Fig. 1.
Arbor forest area and forest stock volume by forest categories in Beijing

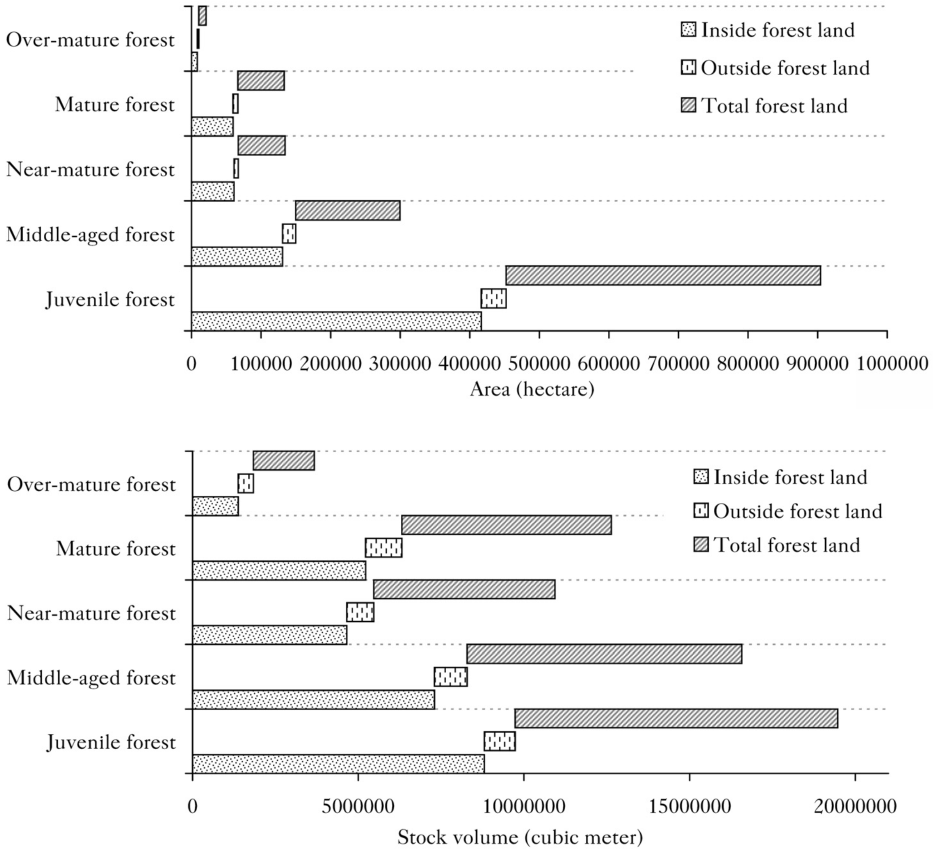

Fig. 2.
Arbor forest area and stock volume by age group in Beijing

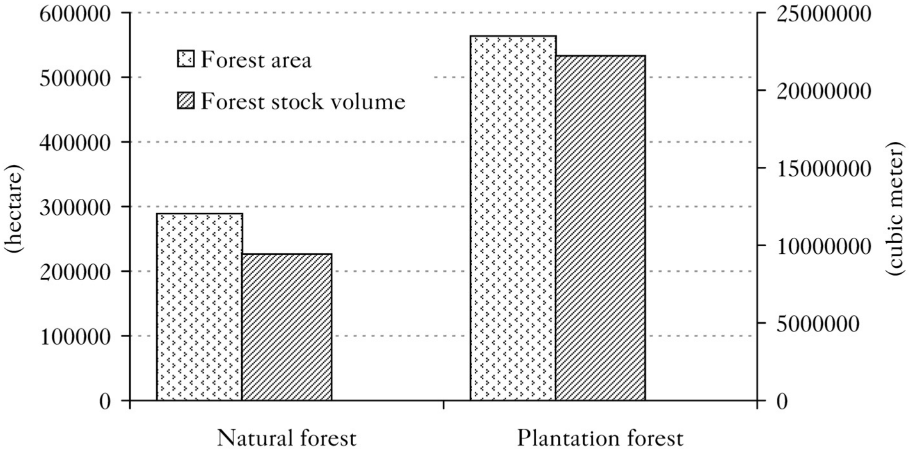

Fig. 3.
Forest area and forest stock volume by forest origin in Beijing

research focus areas by objectively addressing issues and contradictions in forest asset value accounting and their underlying causes.

Systems Analysis Method. The forest asset value accounting system is a complex, independent project with intricate connections among its components. Therefore, it must be guided by systems theory to quantitatively analyze accounting elements in terms of interrelationships, interactions, and mutual constraints. This approach ensures the accuracy of forest asset accounting.

Literature Research Method. The literature research method involves gathering information by studying relevant literature to comprehensively and accurately understand the research subject. We systematically collected and organized literature on natural (forest) resource asset accounting from databases such as Web of Science and China Knowledge Network. Backtracking and retrospective methods were employed to provide a comprehensive overview of the field. This approach helped define the scope and connotations of forest resource asset value accounting, serving as a reference for selecting specific accounting indicators.

Comparative Study Method. The comparative study method involves analyzing similarities and differences between two or more objects. We conducted a comparative analysis of the progress in natural (forest) resource asset accounting in typical Chinese and international regions based on a review of relevant literature. Furthermore, we compared the index system we established with the original one in Beijing to identify the characteristics of our system.

There are trade-offs for each measurement method. In evaluating specific indicators, we focus on improving calculation methods for new indicators in the system we built, such as forest land and trees, carbon sequestration, atmospheric purification, and forest culture, while retaining standard calculation methods specified in existing norms.

Results

THE ESTABLISHMENT AND CONCEPT DEFINITION OF THE VALUE INDEX SYSTEM. Following the central framework of the System of Environmental-Economic Accounting (SEEA) and the concept of the System of National Accounts (SNA) frameworks, we fully consider the characteristics and regional positioning of forest resources in Beijing and screen indicators and corresponding methods in the existing literature. The developed index system is shown in Fig. 4. while the accounting scope of forest resources asset value accounting is found in Table 1.

ACCOUNTING METHODS:

(1) FOREST LAND ASSET ACCOUNTING METHODS. According to the *Norm of Techniques for Estimation of Forest Economic Values* (LY/T 2407-2015) (State Forestry Administration of China, 2015), combined with the characteristics of Beijing forest resources, the forest land assets accounting methods used in this study are: the forest land expecting price method, annuity capitalization method, and forest land cost price method (Table 2).

a. Forest land expecting price method. The forest land expecting price method is based on the forest's sustainable yield and assumes that each rotation period (u) has the same income and expenses. This method calculates from the beginning of afforestation on unforested land and sums the net income of infinite rotation periods into the present value as the value of forest land assets. The calculation formula is:

$$V = \frac{NI_u + NI_a \cdot (1+r)^{u-a} + NI_b \cdot (1+r)^{u-b} + \ldots - \sum_{i=1}^{n_{cr}} I_i \cdot (1+r)^{u-i+1}}{(1+r)^u - 1} - \frac{C}{r} \tag{1}$$

where:

V – value of forest land [yuan·annum^{-1}],

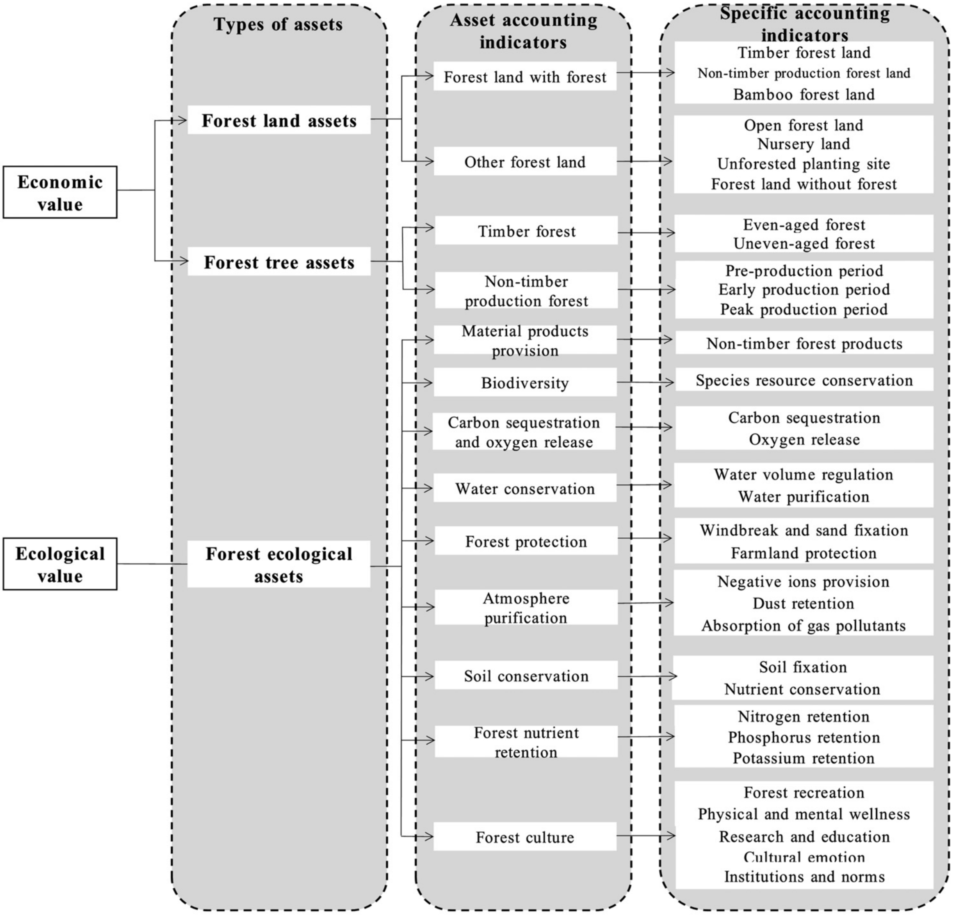

Fig. 4.
The value accounting system

Nl_u – net income from actual forest stand harvesting in annum [yuan·annum^{-1}],
u – rotation period [yuan·annum^{-1}],
NI_a, Ni_b – net income from thinning in annum a and annum b [yuan·annum^{-1}],
I_i – annual direct investment in forest management [yuan·annum^{-1}],
C – average indirect costs of forest management and production including forest protection fees, forestry facility fees, improved seed experiment fees, survey and design fees, production unit management fees, field management fees and financial costs) [yuan·annum^{-1}],
r – interest rate [%],
n_{cr} – cutting rotation [annum].

b. Annuity capitalization method. The annuity capitalization method takes the stable annual income from forest resource assets as the return on capital investment and then values the assets at an appropriate rate of return on investment. This method is used to account for forest resources with the management purpose of sustainable yield. The calculation formula is:

Table 1.
Accounting scope of forest resources asset value accounting in Beijing

Types of forest resources assets	Accounting scope
Forest resources assets	Forest resources that are owned or controlled by a specific entity and can bring economic benefits, including forest land assets, forest tree assets, and forest ecological assets. The accounting of forest resources assets differs between quantity accounting and monetary value accounting; the latter is the focus of our research.
Timber forest land	Forest land and forest trees for the purpose of timber production
Non-timber production forest land	Forest land and forest trees for the purpose of producing fruit, edible oilseeds, beverages, seasonings, industrial raw materials, medicinal herbs and other products
Bamboo forest land	Forest land with bamboo plants and canopy density ≥0.2
Open forest land	Forest land with arbor trees and canopy density 0.10≤ density ≤0.19
Nursery land	Forest land dedicated to forest trees and woody flower seedlings
Unforested planting site	Planting site without crown closure, in which the number of plants preserved after afforestation is greater than or equal to 85% of the design number of plants planted
Forest land without forest	Barren hills, wastelands, logging sites, fire sites, mudflats, sandy wastelands, waste mines, and other sites suitable for afforestation
Pre-production period	Forest trees in the management stage before entering the production period
Early production period	Forest trees in the period from the start of economic production until a certain economic yield is achieved (generally 3-6 years)
Peak production period	Forest trees in the period from the certain economic yield is achieved through abundant and stable production until decline in production
Even-aged forest	Forest stand with one distinct age class
Uneven-aged forest	Forest stand with different age classes
Non-timber forest products	Material products of economic value obtained from forests and their biomass for commercial, industrial, and domestic use, such as cultivation, and breeding
Species resource conservation	Wildlife conservation and genetic information conservation functions provided by forest ecosystem
Carbon sequestration	The function that forests absorb and sequestrate carbon dioxide from the atmosphere through photosynthesis
Oxygen release	The function that forests release oxygen from the atmosphere through photosynthesis
Water regulation	The function that forests produce water, intercept floods, replenish dryness, and intercept precipitation or regulate runoff
Water purification	The function that forests purify water through filtration and adsorption
Windbreak and sand fixation	The function that forests improve desertified land by controlling and fixing drifting sand
Farmland protection	The function that forests protect arable land from wind erosion and sand burial, improve farmland microclimate, and promote stable and high crop yields
Negative ions provision	The function that plants produce negative oxygen ions by photosynthesis
Absorption of gas pollutants	The function that forests reduce the level of toxic substances in the atmosphere
Dust retention	The function that forests reduce wind speed and carrying capacity and block, filter and adsorb dust
Soil fixation	The function that forests improve soil structure, promote the formation of soil mass structure and consolidate the land

Table 1. continued

Types of forest resources assets	Accounting scope
Nutrient conservation	The function that forests maintain soil fertility by decomposition of fallen leaves into organic matter to form humus
Nitrogen retention	The function that forests keep organic and inorganic nitrogen in the soil
Phosphorus retention	The function that forests keep phosphorus in the soil
Potassium retention	The function that forests keep potassium in the soil
Forest recreation	The function that forests provide recreational tourism and nature experiences for humans
Physical and mental wellness	The function that forests improve the state of mind and body as well as healing and wellness
Research and education	The function that forests promote research and nature education
Cultural emotion	The service function of forests on perceived aesthetics, national customs, spirituality and artistic creation, and cultural enhancement
Institutions and norms	The service function of forests in providing social benefits

Table 2.

Forest land asset types and their corresponding accounting methods

Forest land type	Accounting method
Timber forest land	Forest land expecting price method
Non-timber production forest	Forest land expecting price method
Bamboo forest land	Annuity capitalization method
Open forest land	Forest land expecting price method
Nursery land	Forest land cost price method
Young afforested land	Forest land expecting price method
Unforested land	Identify unforested land that can be included in the scope of assets, carry out afforestation and forest management planning, conduct management revenue analysis and determine forest land prices

$$V = \frac{R}{ROI} \tag{2}$$

where:

V – value of forest land [yuan·annum^{-1}],
R – average annual net return [yuan·annum^{-1}],
ROI – return on investment [%].

c. Forest land cost price method. The forest land cost price method calculates the price of forest land through the cost of acquiring forest land and the cost of maintaining the land in its present condition. The calculation formula is:

$$V = F \cdot (1 + ROI)^{n_{ap}} + z \cdot \sum_{i=1}^{n_{cr}} (1 + ROI)^{u-i+1} \tag{3}$$

where:

V – value of forest land [yuan·annum^{-1}],
F – forest land acquisition fee [yuan·hectare^{-1}·annum^{-1}],

ROI – return on investment [%],
n_{ap} – forest land acquisition period [annum],
z – residue ratio of facilities [%].

(2) Forest tree asset accounting methods. According to *Norm of Techniques for Estimation of Forest Economic Values* (LY/T2407-2015) (State Forestry Administration of China, 2015), combined with the characteristics of Beijing forest resources, the forest tree assets accounting methods used in this study are: replacement cost method, strike price comparison method, present earning value method, market-based pricing method, and periodic return capitalization method (Table 3).

a. Replacement cost method. The replacement cost method calculates the asset value by current replacement cost under existing technical conditions and price levels deducting the value of losses. The calculation formula is:

$$V = K \cdot \sum_{i=1}^{n_a} C_i \cdot (1 + ROI)^{n_a - i + 1} \tag{4}$$

where:
V – valuation [yuan·annum^{-1}],
C_i – production cost in annum i based on the current wage and production level [yuan·annum^{-1}],
n_a – forest stand age [annum],
K – comprehensive adjustment coefficient of forest stand quality.

In forest resource asset accounting, because forest stands and their products are non-standardized, their market prices vary with differences in forest tree growth, stand conditions, location class, price level, economic life span, and ecological benefit share. Therefore, it is necessary to establish a stand quality adjustment factor to link the realistic stand asset assessment value with the reference stand asset assessment value and implement the asset assessment to specific patches.

b. Present earning value method. The present earning value method takes the difference between the present value of the net income of the forest assets at final cutting according to the harvest table and forest management cost from the time of accounting to final cutting as the value of forest tree asset. The calculation formula is:

$$V = K \cdot NI \cdot \frac{(1 + ROI)^{l - n_a + 1} - 1}{ROI \cdot (1 + ROI)^{l - n_a + 1}} \tag{5}$$

Table 3.
Forest tree asset types and their corresponding accounting methods

	Forest tree type	Accounting method
Non-timber Production Forest trees	Pre-production period	Replacement cost method
	Early production period	Replacement cost method
	Peak production period	Present earning value method
Timber forest Trees	Even-aged forest	Market-based pricing method (mature and over-mature forest) Present earning value method (middle-aged forest) Replacement cost method (juvenile forest)
	Uneven-aged forest	Periodic return capitalization method

where:

V – valuation [yuan·annum^{-1}],
NI – annual net income during the peak production period [yuan·annum^{-1}],
l – economic life [annum],
n_a – forest stand age [annum],
K – comprehensive adjustment coefficient of forest stand quality.

c. Market-based pricing method. The market-based pricing method, also known as the surplus value method, calculates the forest tree asset through the total income from the timber sale after clear cutting and deducting the operation costs (including taxes, fees and other expenses) and the profits due. The calculation formula is:

$$V = GR - C - P \tag{6}$$

where:

V – value of the forest assets evaluated [yuan·annum^{-1}],
GR – gross revenue from timber sales [yuan·annum^{-1}],
C – timber production and operating costs [yuan·annum^{-1}],
P – profit from timber production and operation [yuan·annum^{-1}].

d. Periodic return capitalization method. The periodic return capitalization method takes the stable periodic income of the forest tree asset as the income of the capital investment and then calculates the asset at an appropriate rate of return on investment. The calculation formula is:

$$V = K \cdot \frac{NI_p}{(1+ROI)^p - 1} - \frac{C}{ROI} \tag{7}$$

where:

V – value of forest assets just after selective cutting [yuan·annum^{-1}],
K – comprehensive adjustment coefficient of forest land quality,
NI_p – net income from selective cutting [yuan·annum^{-1}],
C – annual forest management and maintenance costs [yuan·annum^{-1}],
p – selective cutting cycle [annum].

(3) FOREST ECOLOGICAL ASSET ACCOUNTING METHODS. According to the Specification for Assessment of Forest Ecosystem Services (GB/T 38582-2020) (State Administration of Market Administration, 2020) and the theory of human-forest symbiosis, the main methods of forest ecological resource asset accounting are: distributed measurement method, 'human-forest symbiosis time' comprehensive index coefficient link method, contingent valuation method, taxable pollution equivalent method, equivalent substitution method, and weight equivalent balance method.

a. Distributed measurement method. Dividing a forest's complex ecosystem service functions into relatively independent units for distributed measurement allows forest ecosystem services to be calculated accurately (Fig. 5.).

b. 'Human-forest symbiosis time' comprehensive index coefficient link method. Generally, the value of forest culture is proportional to the amount of time people symbiotically interact with the forest. The value is closely related to the role of natural forces, forest resource elements, and environmental structure. The symbiosis time between people and forests is relative rather than absolute. The value of forest culture in different regions varies along a gradient (Fan *et al.*, 2019).

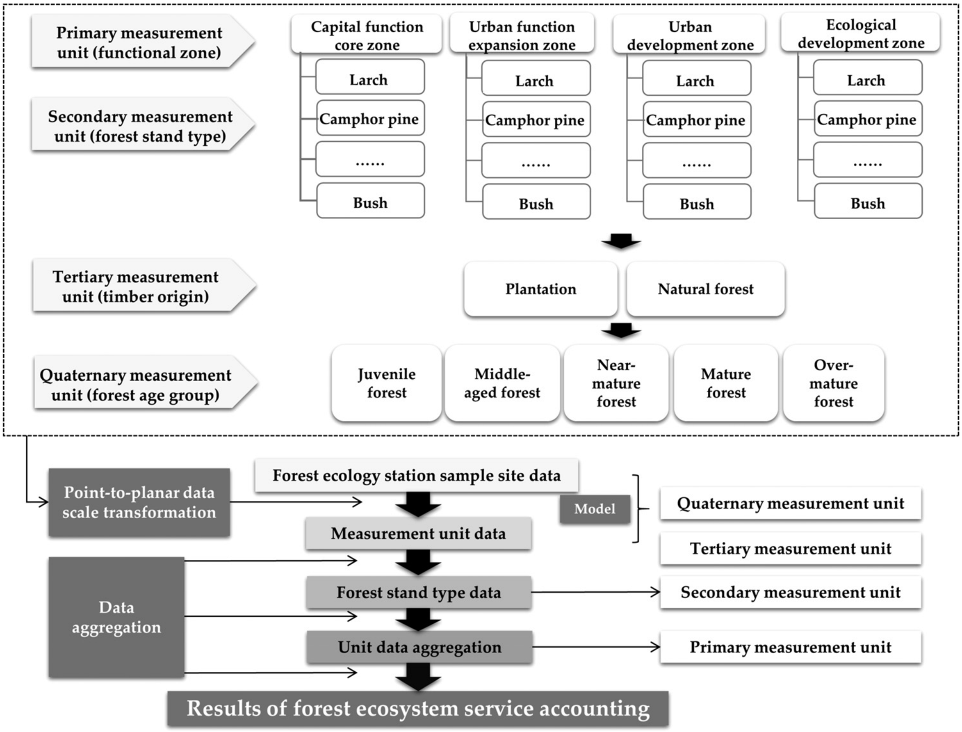

Fig. 5.
Distributed measurement method

Based on the theory of 'human-forest symbiosis time', the level of forest cultural service function is closely related to the richness and quality of forest resources and the cultural service has a spillover effect. Even if people do not enter the forest, the forest also provides certain cultural services to people nearby, such as recreation, air purification, clean water, art inculcation, cultural creativity, and other values. The cultural value of forests within Beijing consists of the basic value and the special value. The basic value is for residential and floating populations. The special value focuses on values during cultural activities in the forest.

In this study, forest culture value accounting consists of qualitative accounting and monetary transformation. These two parts are relatively independent and interrelated, enhancing the scientific and rational nature of the value accounting system. First, the qualitative method of index system weight assessment is applied to approve the weight coefficients of indicators in the index system according to the importance of the indicator factors. The results can then be applied to the qualitative accounting level classification of forest culture value. Second, we use the mathematical method to refine the weight coefficients of several indicators to determine the comprehensive indicator coefficients of forest culture value. Then, the comprehensive index coefficients of forest culture value are included as factors in the formula for forest culture value accounting. Finally, the core theory of 'human-forest symbiosis time' and the forest culture value accounting formula are applied to forest culture value accounting.

c. Contingent valuation method. This method measures the value of goods or services by directly examining the economic behavior of respondents in a hypothetical market using questionnaires to obtain consumers' willingness to pay. This study uses subjective willingness surveys, motivation studies, sampling, questionnaires, and case studies to randomly ask respondents about their perceptions and recognition of forest culture values. We also assess the value respondents place on enjoying intangible benefits of forest culture and their willingness to pay. The results of the sample survey are statistically summarized through primary analysis and benefit analysis and quantified to determine the basic types of intangible benefits of forest culture and indicator weights.
d. Taxable pollution equivalent method. This method is a comprehensive indicator or unit of measurement to measure the degree of environmental pollution from different taxable pollutants according to the harmfulness of their environmental emissions and the technical and economic inputs for treatment.
e. Equivalent substitution method. This method replaces complex and difficult-to-measure natural processes and social effects with equivalent simple and easily measurable natural processes and social effects, while ensuring that the value of a particular ecological asset is the same.
f. Weight equivalent balance method. This method quantitatively accounts for a physical problem and physical process, using a measure of the weight of each component in the total to make its normalized values relatively balanced and comparable.

The evaluation formulas and parameter descriptions of specific forest ecological function indices are shown in Appendix 1 and Appendix 2.

Discussion

RESEARCH COMPARISON. The study has two main objectives. On the one hand, the existing index system does not account for Beijing's unique forest resource characteristics, especially the dominance of protected forests and forests for special purposes covering approximately 96% of the city's total forest area, highlighting the need for a more comprehensive consideration of ecological assets. Integrating the reality of Beijing's forest resources into an index system that aligns with concepts such as green development and national forest cities while addressing the specifics of the region's forest land and ecosystems is crucial. On the other hand, the current index system does not effectively align with Beijing's forest resource development goals as emphasized in the '2022 Forest Resources Management Work Priorities' (https://yllhj.beijing.gov.cn/). Our refined valuation system aims to seamlessly integrate with Beijing's green development objectives and balance regional economic growth with forest conservation. Improvements include:

- We refined the categories of forest land and forest assets and the value of non-timber producing forests into three stages: pre-production, early production, and peak production.
- In addition to the economic value of forest resources such as forest land and trees, we also considered the ecological value of forests. We incorporated ecosystem service values consistent with systems used nationally and by Beijing (Beijing Municipal Bureau of Quality and Technical Supervision, 2009; State Forestry Administration of China, 2015). We included the following values:
  1) enhanced carbon sequestration and atmospheric purification indicators, using the InVEST tool for carbon sequestration; the secondary indicator of dust retention under

the atmospheric purification indicator adds TSP retention and PM10 retention, replacing the original indicator of dust retention using only PM2.5;

2) expanded the atmospheric purification indicator to include TSP and PM10;
3) introduced forest culture value indicators.

More researchers have refined the cultural services provided by ecosystems, introducing indicators such as old and valuable trees (Kan, 2016), cultural education (Qiu, 2013; Wang *et al.*, 2021) and promotion of economic and industrial development (Qiu, 2013; Jiang, 2021). In this study, based on the original monotonous indicators of 'forest recreation' (GB/T 38582-2020) and 'scenic recreation' (Beijing Municipal Bureau of Quality and Technical Supervision, 2009, 2018; Meng, 2011; Li, 2016), the indicators of scientific research and education, culture, and emotion and institutional norms were added.

- We explored a more systematic approach for valuing cultural services, incorporating a comprehensive forest cultivation index and human-forest coexistence time linkage method to reflect cultural value in forest parks as an alternative to survey-based methods with poor applicability in China (Fan *et al.*, 2019; Wang *et al.*, 2019).

RESEARCH LIMITATION. Our research is still at the theoretical and methodological level. Due to data availability and other restrictions, we did not conduct an empirical analysis to compare the advantages and disadvantages of our indicator system with similar systems. Even so, the index system we built for forest resource asset value accounting considers more characteristics of Beijing's forest resources and is more compatible with its development orientation.

Conclusions

- The developed index system for forest resource asset value accounting covers various aspects, including forest land assets, forest tree assets, and forest ecological assets. This system, which consists of 13 asset accounting indicators and 33 specific accounting indicators, provides a robust framework for evaluating the value of forest resources in Beijing.
- The forest land assets accounting methods used in this study are: forest land expecting price method, annuity capitalization method, and forest land cost price method. The forest tree assets accounting methods used in this study are: replacement cost method, strike price comparison method, present earning value method, market-based pricing method, and periodic return capitalization method. The forest ecological resource asset accounting methods used in this study are: distributed measurement method, 'human-forest symbiosis time' comprehensive index coefficient link method, contingent valuation method, taxable pollution equivalent method, equivalent substitution method, and weight equivalent balance method.
- By establishing a comprehensive value accounting system, this study emphasizes the importance of forest resource valuation, serving as a foundation for sustainable management and utilization.
- Accounting techniques and management are two key issues of asset accounting. Currently, there is limited academic research on forest asset accounting management. Further research should focus on the following areas: 1) Track global forest asset accounting management developments for insights. 2) Analyze the impact of different accounting techniques on forest asset value to enhance practices. 3) Study how to use and transfer the research results of forest asset value accounting more reasonably. 4) Study and improve the existing forest asset valuation norms, with a focus on intangible assets such as ecological and environmental services.

Authors' contribution

Z.X. – conceptualization, funding acquisition; L.M., Z.X. – case collections, data collections; G.X., D.Y. – data curation; L.M., Z.Y. – statistical analysis and original draft writing; Z.X., G.X., D.Y., L.M., Z.Y. – review and editing; D.Y., Z.X., G.X. – visualization.
Gu Xiaobing and Li Ming contributed equally to this work.

Conflicts of interest

The authors declare no conflict of interest.

Funding source

This research was funded by the Beijing Municipal Forestry and Parks Bureau under a grant.

Acknowledgments

All authors gratefully acknowledge the funding and project support of the Beijing Municipal Forestry and Parks Bureau, especially the Beijing Forestry Survey and Design Institute for providing the detailed forest resources data.

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Appendix 1.

Calculation formulas and parameter descriptions for forest resource asset in Beijing: forest ecological assets

Forest resources assets	Calculation formulas and parameter descriptions
Material products provision	**Non-timber forest products:** $V = \sum_{j=1}^{n}(Q_j \cdot P_j) \cdot PI$ where: V – Annual value of non-timber products, unit: yuan·annum^{-1}; Q_j – Production of type ‘j’ non-timber forest product, units: kg; P_j – Price of type ‘j’ non-timber forest product, unit: yuan·kg^{-1}; PI – Price index
Biodiversity	**Species resource conservation:** $V = (1 + \sum_{x=1}^{X} REI_x \cdot 0.1 + \sum_{y=1}^{Y} EI_y \cdot 0.1 + \sum_{z=1}^{Z} AI_z \cdot 0.1) \cdot S \cdot A \cdot PI$ where: V – Annual value of species resources conservation in the forest stand, unit: yuan·annum^{-1}; REI_x – Rare and endangered indices of species ‘x’ in the forest stand; X – Number of rare and endangered species; EI_y – Endemic species indices for species ‘y’ in the forest stand; Y – Number of endemic species; AI_z – The age index of ancient tree species ‘z’ in the forest stand; Z – Number of ancient tree species; S – Conservation value of species resources per hectare, unit: yuan·hectare^{-1}·annum^{-1}; A – Forest stand area, unit: hectare
Carbon sequestration and oxygen release	**Carbon sequestration:** $V = (G_{above} + G_{below} + G_{soil} + G_{dead}) \cdot C \cdot PI$ where: V – Annual Value of carbon sequestration in the region, unit: yuan·annum^{-1}; G_{above} – Above-ground carbon stocks, unit: t· hectare^{-1}; G_{below} – Underground carbon stocks, unit: t·hectare^{-1}; G_{soil} – Soil carbon stock, unit: t·hectare^{-1}; G_{dead} – Carbon stocks of dead biomass, unit: t·hectare^{-1}; C – Forest carbon price, unit: yuan·t^{-1}; PI – Price index
	Oxygen release: $V = (1.19 \cdot S \cdot NP \cdot FESCC) \cdot P_o \cdot PI$ where: V – Annual value of oxygen released by the forest stand per annum, unit: yuan·annum^{-1}; S – Forest stand area, unit: hectare; NP – Measured net productivity of the forest stand, unit: t·hectare^{-1}·annum^{-1}; $FESCC$ – Modification factor for forest ecosystem services; P_o – Oxygen price, unit: yuan·t^{-1}
Water conservation	**Water volume regulation:** $V = (10 \cdot S \cdot (P_f - E_f - Q_f) \cdot FESCC) \cdot P_w \cdot PI$ where: V – Annual value of regulated water volume of the forest stand, unit: yuan·annum^{-1}; S – Forest stand area, unit: hectare; P_f – Measured precipitation outside the forest, unit: mm·annum^{-1} ; E_f – Measured evapotranspiration in the forest stand, unit: mm·annum^{-1}; Q_f – Measured rapid surface runoff in the forest stand, unit: mm·annum^{-1}; P_w – The market transaction price of water resources, units: yuan·annum^{-1} ; $FESCC$ – Modification factor for forest ecosystem services
	Water purification: $V = (10 \cdot S \cdot (P_f - E_f - Q_f) \cdot FESCC) \cdot C \cdot PI$ where: V – Annual water purification value of the forest stand, unit: yuan·annum^{-1}; S – Forest stand area, unit: hectare; P_f – Measured precipitation outside the forest stand, unit: mm·annum^{-1}; E_f – Measured evapotranspiration in the forest stand, unit: mm·annum^{-1}; Q_f – Measured rapid surface runoff in the forest stand, unit: mm·annum^{-1}; C – Water purification costs, unit: yuan·annum^{-1}

Appendix 1. continued (2)

Forest resources assets		Calculation formulas and parameter descriptions
Forest protection		**Windbreak and sand fixation:** $V = C \cdot (S \cdot (Y_2 - Y_1) \cdot FESCC) \cdot PI$ where: V – Annual value of windbreak and sand fixation by the forest stand, unit: yuan·annum^{-1}; S – Area of windbreak and sand fixation forest stand, unit: hectare; Y_2 – Wind erosion modulus of non-forested land, unit: t·hectare^{-1}·annum^{-1}; Y_1 – Wind erosion modulus of forested land, unit: t·hectare^{-1}·annum^{-1}; C – Cost of sand fixation, unit: yuan·t^{-1}
		Farmland protection: $V = k \cdot P \cdot AP \cdot S \cdot PI$ where: V – Annual value of farmland protection by the forest stand , unit: yuan·annum^{-1}; k – An average of 1 hectare of farmland protection forest protect 19 hectare of farmland; P – Prices of crops and pastures, unit: yuan·kg^{-1}; AP – Average increase in crop and pasture yield, unit: kg·hectare^{-1}·annum^{-1}; S – Area of the farmland protection forest stand, unit: hectare.
Atmosphere purification		**Negative ions provision:** $V = 5.256 \cdot 10^{15} \cdot S \cdot H \cdot FESCC \cdot C \cdot (Q - 600) / L \cdot PI$ where: V – Value of negative ions provision by the forest tenure year, unit: yuan·annum^{-1}; S – Forest stand area, unit: hectare; H – Measured stand height, unit: m; $FESCC$ – Modification factor for forest ecosystem services; C – Negative ions production costs, unit: yuan·prickle^{-1}; Q – Measured concentration of negative ions in the forest stand, unit: prickle·cm^{-3}; L – Negative ions lifetime, unit: min.
	Absorption of gas pollutants	**Absorption of sulfur dioxide:** $V = (Q_{SO_2} \cdot S \cdot FESCC / 1000) \cdot C_{SO_2} \cdot PI$ where: V – Annual value of sulfur dioxide absorption by the forest stand, unit: yuan·annum^{-1} ; Q_{SO_2} – Measured amount of sulfur dioxide absorbed by the forest stand per hectare, unit: kg·hectare^{-1}·annum^{-1}; S – Forest stand area, unit: hectare; C_{SO_2} – Sulphur dioxide treatment costs, unit: yuan·kg^{-1}.
		Absorption of fluoride: $V = (Q_F \cdot S \cdot FESCC / 1000) \cdot C_F \cdot PI$ where: V – Annual value of fluoride absorption by the forest stand, unit: yuan·annum^{-1}; Q_F – Measured amount of fluoride absorbed by the forest stand per hectare, unit: kg·hectare^{-1}·annum^{-1}; S – Forest stand area, unit: hectare; C_F – Fluoride treatment costs, unit: yuan·kg^{-1}
		Absorption of nitrogen oxides: $V = (Q_{NO} \cdot S \cdot FESCC / 1000) \cdot C_{NO} \cdot PI$ where: V – Annual value of nitrogen oxide absorption by the forest stand, unit: yuan·annum^{-1}; Q_{NO} – Measured amount of nitrogen oxides absorbed by the forest stand per hectare, unit: kg·hectare^{-1}·annum^{-1}; S – Forest stand area, unit: hectare; C_{NO} – Nitrogen oxide treatment costs, unit: yuan·kg^{-1}

Appendix 1. continued (3)

Forest resources assets	Calculation formulas and parameter descriptions	
	Dust retention	**TSP retention:** $V = (Q_{TSP} \cdot S \cdot FESCC/1000 - Q_{PM_{10}} - Q_{PM_{2.5}}) \cdot C_{TSP} + (V_{PM_{10}} + V_{PM_{2.5}}) \cdot PI$ where: V – Annual value of dust retention by the forest stand, unit: yuan·annum^{-1}; Q_{TSP} – Measured annual delayed TSP in the forest stand, unit: kg·hectare^{-1}; S – Forest stand area, unit: hectare; $FESCC$ – Modification factor for forest ecosystem services; $Q_{PM_{10}}$ – Evaluated annual delayed PM_{10} in the forest stand, unit: kg·annum^{-1}; $Q_{PM_{2.5}}$ – Evaluated annual delayed $PM_{2.5}$ in the forest stand, unit: kg·annum^{-1}; C_{TSP} – Dust removal costs, unit: yuan·kg^{-1}; $V_{PM_{10}}$ – Annual value of PM_{10} retention by the forest stand, unit: yuan·annum^{-1}; $V_{PM_{2.5}}$ – Annual value of $PM_{2.5}$ retention by the forest stand, unit: yuan·annum^{-1}
		PM_{10} retention: $V = 10 \cdot Q_{PM_{10}} \cdot S \;\; n_{ae} \cdot FESCC \cdot LAI \cdot C_{PM_{10}} \cdot PI$ where: V – Annual value of PM_{10} retention by the forest stand, unit: yuan·annum^{-1}; $Q_{PM_{10}}$ – Measured the amount of PM_{10} per unit leaf area of the forest stand, unit: g·m^{-2}; S – Forest stand area, unit: hectare; n_{ae} – Annual elution times; LAI – Leaf area index; $C_{PM_{10}}$ – PM_{10} removal costs, unit: yuan·kg^{-1}
		Adsorption of PM2.5: $V = 10 \cdot Q_{PM_{2.5}} \cdot S \;\; n_{ae} \cdot FESCC \cdot LAI \cdot C_{PM_{2.5}} \cdot PI$ where: V – Annual value of $PM_{2.5}$ retention by the forest stand, unit: yuan·annum^{-1}; $Q_{PM_{2.5}}$ – Measured the amount of $PM_{2.5}$ per unit leaf area of the forest stand, unit: g·m^{-2}; S – Forest stand area, unit: hectare; n_{ae} – Annual elution times; LAI – Leaf area index; $C_{PM_{2.5}}$ – $PM_{2.5}$ removal costs, unit: yuan·kg^{-1}
Soil Conservation	**Soil fixation:** $V = (S - (X_2 - X_1) \cdot FESCC) \cdot C / \rho \cdot PI$ where: V – Annual value of soil fixation by the forest stand, unit: yuan·annum^{-1}; S – Forest stand area, unit: hectare; X_2 – Soil erosion modulus in non-forested land, unit: t·hectare^{-1}·annum^{-1}; X_1 – Measured soil erosion modulus in forested land in the forest stand, unit: t·hectare^{-1}·annum^{-1}; C – The cost of excavating and transporting soil, unit: yuan·m^{-3}; ρ – Soil bulk density, unit: g·m^{-3}	
	Nutrient conservation	**Nitrogen loss reduction:** $V = S \cdot Q_N \cdot FESCC \cdot P_{DAP} \cdot PI$ where: V – Annual value of nitrogen loss reduced due to the soil fixation by the forest stand, unit: yuan·annum^{-1}; S – Forest stand area, unit: hectare; Q_N – Measured soil nitrogen content in the forest stand, unit: [%]; X_2 – Soil erosion modulus in non-forested land, unit: t·hectare^{-1}·annum^{-1}; X_1 – Measured soil erosion modulus in forested land in the forest stand, unit: t·hectare^{-1}·annum^{-1}; P_{DAP} – Price of diammonium phosphate fertilizer, unit: yuan·t^{-1}; R_N – Nitrogen content of diammonium phosphate fertilizer, unit: [%]

Appendix 1. continued (4)

Forest resources assets		Calculation formulas and parameter descriptions
Soil conservation	Nutrient conservation	**Phosphorus loss reduction:** $V = (S \cdot Q_P \cdot (X_2 - X_1) \cdot FESCC) \cdot P_{DAP} / R_P \cdot PI$ where: V – Annual value of phosphorus loss reduced due to the soil fixation by the forest stand, unit: yuan·annum^{-1}; S – Forest stand area, unit: hectare; Q_P – Measured soil phosphorus content in the forest stand, unit: [%]; X_2 – Soil erosion modulus in non-forested land, unit: t·hectare^{-1}·annum^{-1}; X_1 – Measured soil erosion modulus in forested land in the forest stand, unit: t·hectare^{-1}·a^{-1}; P_{DAP} – Price of diammonium phosphate, unit: yuan·t^{-1}; R_P – Phosphorus content of diammonium phosphate fertilizer, unit: [%]
		Potassium loss reduction: $V = (S \cdot Q_K \cdot (X_2 - X_1) \cdot FESCC) \cdot P_{KCl} / R_K \cdot PI$ where: V – Annual value of potassium loss reduced due to the soil fixation by the forest stand, unit: yuan·annum^{-1}; S – Forest stand area, unit: hectare; Q_K – Measured soil potassium content in the forest stand, unit: [%]; X_2 – Soil erosion modulus in non-forested land, unit: t·hectare^{-1}·annum^{-1}; X_1 – Measured soil erosion modulus in forested land in the forest stand, unit: t·hectare^{-1}·annum^{-1}; P_{KCl} – Price of potassium chloride fertilizer, unit: yuan·t^{-1}; R_K – Potassium content of potassium chloride fertilizer, unit: [%]
		Organic matter loss reduction: $V = (S \cdot Q_{O.M.} \cdot (X_2 - X_1) \cdot FESCC) \cdot C_{O.M.} \cdot PI$ where: V – Annual value of organic matter loss reduced due to soil fixation by the forest stand, unit: yuan·annum^{-1}; S – Forest stand area, unit: hectare; $Q_{O.M.}$ – Measured organic mass of soil in the forest stand, unit: [%]; X_2 – Soil erosion modulus in non-forested land, unit: t·hectare^{-1}·annum^{-1}; X_1 – Measured soil erosion modulus in forested land in the forest stand, unit: t·hectare^{-1}·annum^{-1}; $C_{O.M.}$ – Organic matter price, unit: yuan·t^{-1}
Forest nutrient		**Nitrogen retention:** $V = S \cdot Q_{NH} \cdot NP \cdot FESCC \cdot P_{DAP} \cdot PI$ where: V – Annual value of nitrogen retention by the forest stand, unit: yuan·annum^{-1}; S – Forest stand area, unit: hectare; Q_{NH} – Measured content of ammonia in trees, unit: [%]; NP – Measured net productivity of the forest stand, unit: t·hectare^{-1}·annum^{-1}; P_{DAP} – Price of diammonium phosphate fertilizer, unit: yuan·t^{-1}
		Phosphorus retention: $V = S \cdot Q_P \cdot NP \cdot FESCC \cdot P_{DAP} \cdot PI$ where: V – Annual value of phosphorus retention by the forest stand, unit: yuan·annum^{-1}; S – Forest stand area, unit: hectare; Q_P – Measured content of phosphorus in trees, unit: [%]; NP – Measured net productivity of the forest stand, unit: t·hectare^{-1}·annum^{-1}; P_{DAP} – Price of diammonium phosphate fertilizer, unit: yuan·t^{-1}
		Potassium retention: $V = S \cdot Q_K \cdot NP \cdot FESCC \cdot P_{K_2O} \cdot PI$ where: V – Annual value of potassium retention by the forest stand, unit: yuan·annum^{-1}; S – Forest stand area, unit: hectare; Q_K – Measured content of phosphorus in trees, unit: [%]; NP – Measured net productivity of the forest stand, unit: t·hectare^{-1}·annum^{-1}; P_{K_2O} – Price of potassium chloride fertilizer, unit: yuan·t^{-1}

Appendix 1. continued (5)

Forest resources assets	Calculation formulas and parameter descriptions
Forest culture	**Forest recreation; physical and mental wellness; research and education; cultural emotion; institutions and norms:** $V=\sum_{i=1}^{n}(p_i\cdot k_i\cdot\frac{m_i}{M}\cdot Tf_i+pt_i\cdot Tt_i)\cdot\alpha_i\cdot G_i$ where: V – Annual value of forest cultural services in the region, unit: yuan·annum^{-1}; p_i – Resident population in region ‘i’ during the year, unit: person; k_i – Forest cover rate in region ‘i’ unit: [%]; m_i – Forest stock volume per hectare in region ‘i’ unit: m^3·hectare^{-1}; M – Forest stock volume per hectare in China, unit: m^3·hectare^{-1}; Tf_i – The basic time of man-forest symbiosis in region ‘i’, unit: h; According to the study of China National Bureau of Statistics, the basic living time of man-forest symbiosis in China totals 2h/d, about 0.0833 y[3]; pt_i – Annually number of people participate forest recreation in region ‘i’, unit: h;Tt_i – Time of each trip in region ‘i’, unit: h, according to the data released by the China Tourism Academy and the National Tourism Data Center, the average travel time of Chinese tourists is about 4.56 diem, about 0.0125 annum[4]; α_i – The cultural comprehensive index coefficient in region ‘i’, according to the total score of the weight of each index of the ‘forest cultural value index system’, the standardized coefficient between 0-2 was obtained; G_i – GDP per capita in region ‘i’, unit: yuan

Appendix 2.

Explanation of the arguments of the calculation formulas in the text

Argument	Calculation formulas and parameter descriptions
Combined adjustment factor for forest stands	**Forest stand growth condition adjustment factor K_1 and K_2:** 1) **Timber forest:** a. For the valuation of forest tree assets on young and unstocked plantations, the K_1 and K_2 adjustments are derived from the preservation rate and the tree height. $K_1=\begin{cases}\frac{r}{R} & r<R\\ 1 & r\geq R\end{cases},\ K_2=\frac{h}{H}$ where: r – Preservation rate of the tree number in the assessed forest stand, unit: [%]; R – Survival rate, unit: [%]; h – Average tree height of the assessed forest stand, unit: m; H – Average tree height in the reference stand, unit: m. b. For the valuation of forest tree assets above middle-aged, K_1 and K_2 adjustments are derived from both the stock volume per unit area and the average diameter at breast height of the stand. $K_1=\frac{m}{M},\ K_2=\frac{d}{D}$ where: m – Stock volume per unit area of the assessed stand, unit: m^3·hectare^{-1}; M – Stock volume per unit area of the reference stand, unit: m^3·hectare^{-1}; d – Average diameter at breast height of the assessed stand, unit: m; D – Average diameter at breast height of the reference stand, unit: m.

Appendix 2. coninued (2)

Argument	Calculation formulas and parameter descriptions
	2) **Economic forest:** a. For the valuation of pre-production economic forest timber assets, the adjustment of K_1 and K_2 is usually determined by K_1, $K_{2.1.}$ and $K_{2.2.}$ $K_1 = \begin{cases} \frac{r}{R} & r < R \\ 1 & r \geq R \end{cases}, \quad K_{2,1} = \frac{h}{H}, \quad K_{2,2} = \frac{c}{C}$ where: r – The tree number of assessed forest stand; R – Standard afforestation tree number or tree number of reference stand; h – Average height of the assessed stand, unit: m; H – Average height of the reference stand, unit: m; c – Average crown width of the assessed stand, unit: m; C – Average crown width of the reference stand, unit: m. b. For the valuation of economic forest stand assets after the pre-production period, adjustments to K_1 and K_2 need to take into account a correction for the yield of economic forest products in addition to the canopy width of the economic forest stand. $K_1 = \frac{m}{M}$ where: m – Yield per unit area of the assessed stand, unit: t·hectare^{-1}; M – Yield per unit area of the reference stand, unit: t·hectare^{-1}.
	3) **Bamboo forest:** The adjustment factor for bamboo stands shall be determined by reference to the difference in age structure, evenness, neatness, standing, management grade, growth grade, etc. between the transaction case and the assessed bamboo stand assets. $K_1 = \frac{d \cdot h}{D \cdot H}, \quad K_2 = \frac{r}{R}$ where: d – Average diameter at breast height of the assessed bamboo forest, unit: m; D – Average diameter at breast height of the reference bamboo forest, unit: m; h – Average height of the assessed bamboo stand, unit: m; H – Average height of the reference bamboo stand, unit: m; r – Plant number per unit area of the assessed stand; R – Plant number per unit area of the reference stand.
	Adjustment factor of forest stand quality K_3: $K_3 = \frac{s}{S}$ where: s – Stock volume at final cutting of a standard stand of the stand class to which the assessed forest stand belongs, unit: t·hectare^{-1}; S – Stock volume at final cutting of standard stand of the stand class to which the reference stand belongs, unit: t·hectare^{-1}.
	Adjustment factor of topographical advantages K_4: $K_4 = \frac{t}{T}$ where: t – Stumpage price at final cutting of the standard stand to which the assessed stand belongs, unit: yuan; T – Stumpage price at final cutting of a standard stand in the stand class to which the reference stand belongs, unit: yuan.
	Adjustment factor of other elements: Adjustment factor of other elements include the impact of pests and diseases, natural disasters, dead wood, over-intensive oleoresin tapping, excessive development of the non-timber forest products, concentration of forest land, and forest industry policy on the valuation.

Appendix 2. coninued (3)

Argument	Calculation formulas and parameter descriptions
Modification factor for forest ecosystem services	When existing field measurements are not representative of the structure and function of the same target stand type in the same ecological unit, the Forest Ecological Function Correction Coefficient (FESCC) is used to evaluate the ratio of factors such as target stand biomass to factors such as measured stand biomass in the same valuation unit. The formula is: $FESCC=\frac{B_c}{B_o}=\frac{BEF\cdot V}{B_o}$ where: B_c – Biomass of the assessed stand, unit: kg·m^{-3}; B_o – Biomass of the measured stand, unit: kg·m^{-3}; BEF – Storage to biomass conversion factor; V – Storage volume of the assessed stand, unit: m^3.
Price index	$PI = (D_r + L_r)/2$ where: PI – Price index; D_r – Average bank deposit rates, unit: [%]; L_r – Average lending rates of banks, unit: [%].

STRESZCZENIE

Udoskonalenie systemu wyceny zasobów leśnych – studium przypadku: Pekin, Chiny

Zasoby leśne odgrywają kluczową rolę w łagodzeniu zmian klimatu i ochronie różnorodności biologicznej. Ocena ich wartości stanowi zasadniczy krok w stronę precyzyjnej wyceny zasobów przyrodniczych, rzucając światło na konsekwencje działalności człowieka dla tych bezcennych dóbr, ponadto pozwala w pełni docenić wartość produktów pochodzących z lasów. W Pekinie, centralnym punkcie rozwoju ekologicznego i środowiskowego, oczywiste są skomplikowane relacje między lasami a bezpieczeństwem ekologicznym. Tamtejsze lasy stanowią nie tylko fundament stabilności ekologicznej, ale także wspierają zrównoważony rozwój gospodarczy i społeczny. W tym kontekście ważne jest zrozumienie gospodarczego znaczenia zasobów leśnych w Pekinie: poprzez stworzenie kompleksowego systemu rachunkowości wartości aktywów leśnych, dającego naukowe podstawy przyszłych decyzji i polityk w tym regionie.

Pierwszym krokiem w tworzeniu tego systemu jest identyfikacja ograniczeń w bieżącym księgowaniu zasobów leśnych i zaproponowanie obszarów wymagających udoskonalenia. W badaniu uwzględniono odróżniające cechy zasobów leśnych Pekinu (ryc. 1-3). Należą do nich rozległe obszary lasów chronionych i lasów specjalnego przeznaczenia, wysoki udział plantacji oraz lasów młodych i średnich klas wieku, a także duża liczba starych i cennych drzew. Na podstawie tych atrybutów stworzono system współczynników (wskaźników) wyceny zasobów leśnych w Pekinie.

Aby opracować kompleksowy system wskaźników, zastosowano metodę analizy systematycznej, przegląd literatury i badania porównawcze. Powstały system składa się z 13 księgowych wskaźników aktywów i 33 szczegółowych wskaźników rachunkowych, zapewniających solidne ramy dla wyceny zasobów leśnych w Pekinie (ryc. 4; tab. 1). System ten obejmuje 3 kategorie zasobów: gruntów leśnych, drzew leśnych i aktywów ekologicznych. Metody wyceny aktywów gruntów leśnych zastosowane w tym badaniu obejmują metodę oczekiwanej ceny gruntów leśnych, metodę kapitalizacji renty oraz metodę kosztu gruntów leśnych (tab. 2). Metody wyceny aktywów drzew leśnych opierały się na metodzie kosztu odtworzenia, metodzie porównania ceny wykonania, metodzie bieżącej wartości dochodowej, metodzie wyceny rynkowej oraz metodzie okresowej kapitalizacji zwrotu (tab. 3). Metody wyceny leśnych zasobów ekologicznych zastosowane w badaniu to: rozproszona metoda pomiaru (ryc. 5), kompleksowa metoda powiązania współczynników „czasu symbiozy człowieka z lasem”, metoda wyceny warunkowej, metoda ekwiwalentu zanieczyszczeń podlegających opodatkowaniu, metoda substytucji równoważnej oraz metoda bilansu równoważnikowego.

Omówiono też cechy pekińskiego systemu rachunkowości zasobów leśnych. Wypracowany system nie jest ograniczony regionalnie. Wyniki mają znaczenie uniwersalne, przyczyniając się do bardziej świadomego i odpowiedzialnego podejścia do zarządzania zasobami leśnymi. Promując zrównoważone praktyki poprzez świadomy proces decyzyjny, można wspólnie zmierzać w kierunku bardziej zrównoważonego ekologicznie i dostatniego świata.