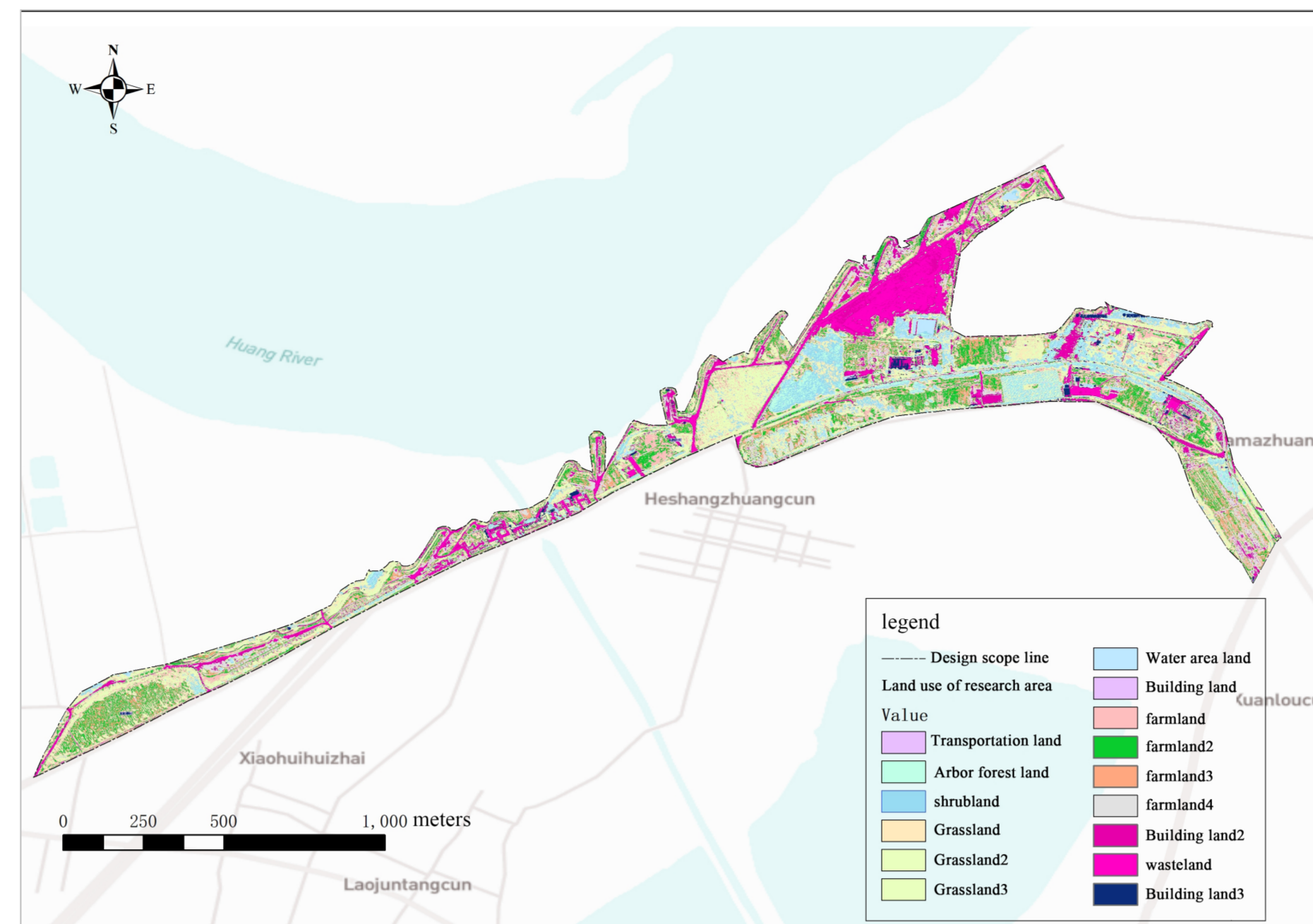


Study on Ecosystem GEP Accounting of Liuyuankou National Water Conservancy Scenic Area in Kaifeng

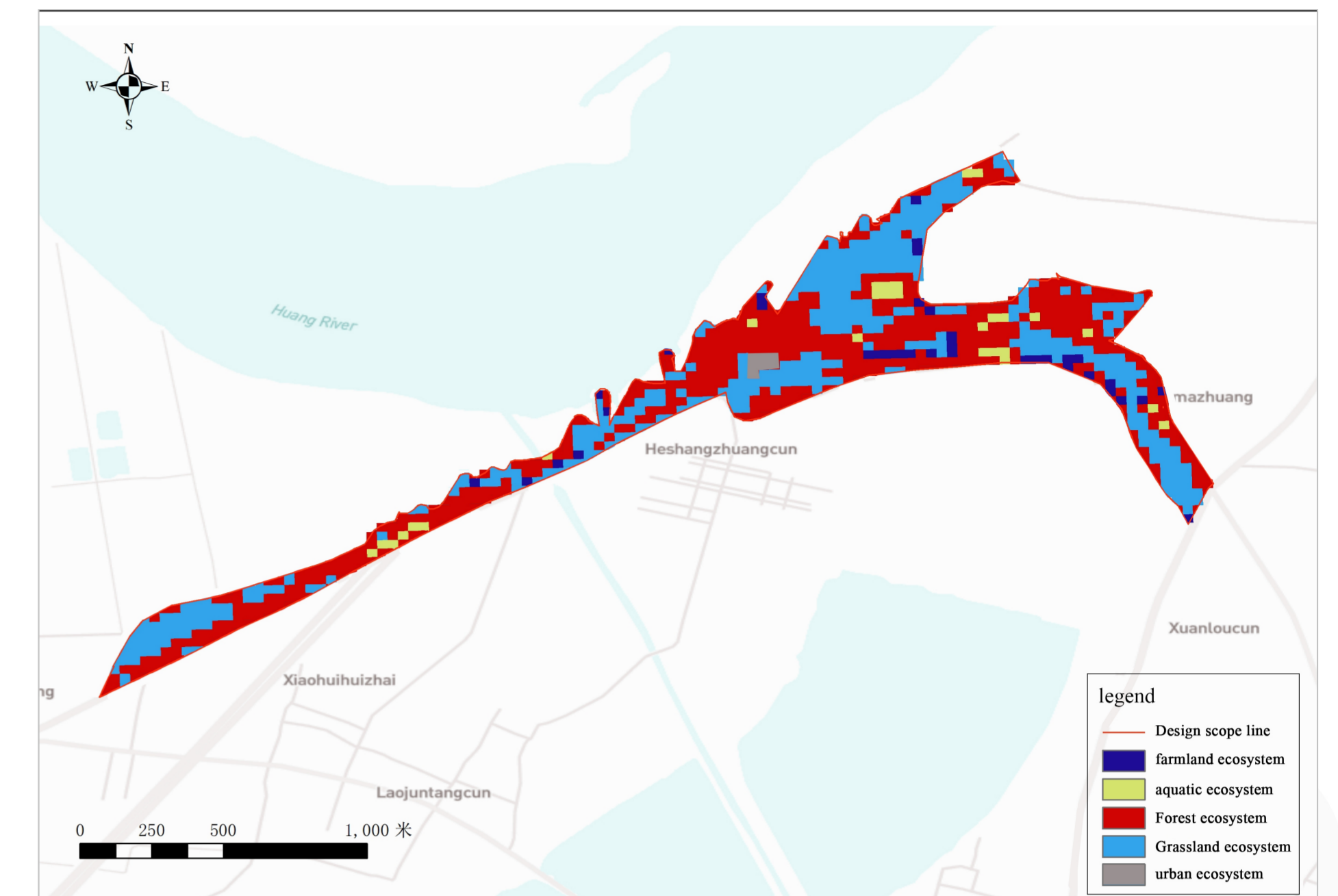
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Objectives

In order to accurately evaluate the comprehensive benefits of water conservancy scenic spots and promote the realization of the value of ecological products in water conservancy scenic spots, this study improved the list of ecological products in water conservancy scenic spots through literature review, survey interviews, and on-site measurements, refined the indicators and methods for monetization of cultural service value accounting, and conducted value accounting with Liuyuankou Water Conservancy Scenic Spot in Kaifeng as the research object.



Land use map of the research area



Ecological system division of the research area

Methods

Referring to existing research results, the accounting indicators for the ecological system in the study area are set to three major types: material products, regulatory services, and cultural services. The material products provided by the research area mainly include agricultural products, forestry products, and water resources. Based on the availability of data and the difficulty of accounting, combined with the characteristics of the ecosystem and types of ecological products in the study area, this study sets the accounting indicators for regulating services as water source conservation, carbon sequestration, oxygen release, and climate regulation. Soil conservation, wind and sand prevention, coastal zone protection, and water quality purification do not exist in the ecosystem service functions

Accounting function	Accounting indicators	evaluation method	Accounting formula
Material supply	agricultural products	Market Value Method	$V_p = \sum_{i=1}^n EP_i \times P_i$ In the formula, V_p is the total value (yuan) of the material products provided by the ecosystem, EP_i is the output of the i -th type of material ecological products, and P_i is the price of the i -th type of material ecological products.
	forest products	Market Value Method	$Q_{CO_2} = \sum_{i=1}^n A_i \times (E_i - S_i - EC_i) \times 10^{-11}$ In the formula, Q_{CO_2} is the total amount of water source conservation, in m^3/a ; A_i is the area of the i -th ecosystem, in square meters; E_i is the annual runoff precipitation of the i -th ecosystem, in mm/a; S_i is the surface runoff of the i -th ecosystem, in mm/a; EC_i is the annual evaporation of the i -th ecosystem, in mm/a, and n is the number of ecosystems.
	water resource	Shadow engineering method	Calculate the carbon sequestration amount in the study area using the carbon sequestration rate method. The carbon sequestration rate (SCSR) of the i -th ecosystem, the product of the area S_i of the i -th ecosystem, and the coefficient of C conversion to CO_2 ($M_{CO_2}/M_C=44/12$), is used to represent the carbon sequestration amount of the i -th ecosystem. By adding n , the actual carbon sequestration amount of n ecosystems can be obtained. $Q_{CO_2} = \sum_{i=1}^n S_i \times SCSR_i \times 33F_i$ The market value method is used to calculate the value of carbon sequestration services, V_{CO_2} . The value of carbon sequestration services, V_{CO_2} , is equal to the product of the total amount of carbon sequestration (Q_{CO_2}) and the price of carbon dioxide P_{CO_2} . $V_{CO_2} = Q_{CO_2} \times P_{CO_2}$
Regulating services	carbon sequestration	Market Value Method	Select the oxygen release rate as the accounting indicator for the oxygen release function of the ecosystem. According to the Chemical equation of photosynthesis, every 1mol of carbon dioxide
	oxygen release	Market Value Method	absorbed by plants will release 1mol of oxygen. The NEP can be obtained by subtracting the consumption of oxygen respiration from the primary productivity (NPP), or according to the correlation conversion coefficient between NPP and NEP, and then calculate the quantity of oxygen released by the ecosystem: $Q_{O_2} = M_{O_2} / M_{CO_2} \times Q_{CO_2}$ In the formula, Q_{O_2} is the oxygen release capacity of the ecosystem (O_2/a), M_{CO_2}/M_{O_2} is the coefficient of CO_2 conversion to O_2 , and Q_{CO_2} is the carbon sequestration capacity of the ecosystem (C/a). Using the market value method (i.e. oxygen production price) to calculate the value of oxygen provided by ecosystems. The calculation formula for the value of oxygen release is as follows: $V_{O_2} = Q_{O_2} \times C_{O_2}$ In the formula, V_{O_2} is the oxygen release value of the ecosystem (yuan/a), Q_{O_2} is the amount of oxygen released from the ecosystem (t oxygen/a), and C_{O_2} is the price of industrial oxygen production (yuan/t).
culture services	activities	Opportunity cost Method	In the formula, Q_{O_2} is the absorbed atmospheric heat (J/a), P_c is the Specific heat capacity of air ($J/m^3 \cdot ^\circ C^{-1}$), V is the volume of air in the ecosystem (m^3), ΔT is the measured temperature difference inside and outside the ecosystem on day i ($^\circ C$), N is the total number of days during the year when the daily maximum temperature exceeds $20^\circ C$. $V = T_{max} \times S_{max} = T_{max} \times A_{max} \times S_{max}$ In the formula, V represents the total value of leisure tourism, T_{max} is the average nighttime total price per hour, S_{max} is the local unit time per capita wage, T_{max} is the total number of leisure tourists, A_{max} is the average nighttime unit.
		Opportunity cost Method	$V_{CO_2} = Q_{CO_2} \times P_{CO_2}$
	Catering services	Cost benefit method	In the formula, V_{cat} represents the value of catering services, N_{cat} represents the number of catering facilities, P_{cat} is the per capita food and beverage consumption price, C_{cat} refers to the operating costs, which include the rental cost of catering facilities (R_{cat}), employee compensation (S_{cat}), and annual maintenance cost (M_{cat}). $V_{cat} = N_{cat} \times P_{cat} - C_{cat} = N_{cat} \times P_{cat} - R_{cat} - S_{cat} - M_{cat}$
		Market Value Method	In the formula, V_{cat} is the land premium, A is the area of the property, R is the property premium coefficient.
Land premium	Market Value Method		

Accounting Indicators and Methods

of the region, so they are not included in the accounting indicators for regulating services in this study. For the specific water facility area of the water conservancy scenic area, it undertakes a series of tourism, science education, cultural activities, and catering services, and supplements the construction of cultural service accounting formulas applicable to the specific ecological unit of the water conservancy scenic area.

Results

After calculation, the total ecosystem production value of the Liuyuankou Water Conservancy Scenic Area in Kaifeng is 59.3846 million yuan, the value of material products provided is 1.7887 million yuan, the value of regulatory services is 7.3651 million yuan, and the value of cultural services is 50.238 million yuan. Among them, the value of cultural services accounts for the highest proportion, accounting for 85%, followed by regulatory services and material product supply, accounting for 12% and 3%, respectively.

The key to promoting the sorting of ecological product lists and the application of value evaluation results in water conservancy scenic spots is to promote the realization of their ecological product values. This is a systematic project that combines theoretical and practical aspects, and requires the joint efforts of various

levels of government and departments, water conservancy scenic spot organization and management institutions, operating institutions, enterprises, individuals, and other parties. We should strengthen the promotion and promotion of concepts and practices, and strengthen the trial calculation practice of evaluation method systems Promote the exploration and application of mechanisms and pathways for realizing the value of ecological products in various aspects.

functional category	Accounting indicators	physical quantity	Value (10000 yuan)		Total (10000 yuan)	
			Value (10000 yuan)	Proportion (%)	Value (10000 yuan)	Proportion (%)
Material products	agricultural products	24300kg	7.78	0.13%	178.87	3%
	forest products	3279.18m ³	170.91	2.88%		
	water resource	12600m ³	0.17	0.00%		
Regulating services	carbon sequestration	799.49t	4.63	0.08%	736.51	12%
	climate regulation	11710202.13kw·h	655.77	11.04%		
	water conservation	83825.1776m ³	58.67	0.99%		
	oxygen release	158.57t	17.44	0.29%		
culture services	Tourism	994583.33h	3293.36	55.46%	5023.09	85%
	Science education	62562.5h	319.78	5.38%		
	activities	80000 人次	620.8	10.45%		
	Catering services	231000 人次	103.95	1.75%		
	Land premium	57100 m ²	685.2	11.54%		
Total (10000 yuan)					5938.46	