International Journal of Cognitive Informatics and Natural Intelligence
Volume 18 • Issue 1 • January-December 2024

Fuzzy Comprehensive Evaluation-Based Development System for Eco-Agricultural Tourism Resources

Ling Hu
Xinyang Vocational and Technical College, China

Chunying Xu
Qinghai Communications Technical College, China

ABSTRACT

This manuscript outlines a systematic evaluation of agricultural eco-tourism resources, focusing on the Taihang Mountain Grand Canyon scenic area. Employing fuzzy mathematics principles, we construct a comprehensive evaluation model to assess various dimensions of agro-ecotourism potential. The framework includes hierarchical levels (A, B1-B3, C1-C8) covering ecological resource value, environment condition, and tourism development. Using the fuzzy comprehensive evaluation method, we determine indicator weights via expert assessments and statistical analyses. Notably, ecological resource value and environment quality emerge as pivotal criteria. The resulting comprehensive score of 82.875 suggests Grade IV suitability for eco-tourism development. Our findings support strategic planning and sustainable management, emphasizing the importance of ecological preservation amidst China's urbanization. Graphical representations and detailed steps provided enhance practicality for sustainable tourism researchers and practitioners.

KEYWORDS

Ecological Agriculture, Fuzzy Evaluation, Rural Tourism, Tourism Resources

INTRODUCTION

In recent years, the rapid urbanization in China has brought about a host of environmental challenges, including the proliferation of “cement deserts” and the exacerbation of the “heat island effect” (Zhou, 2023). In response to these pressing issues, the field of ecotourism within the tourism industry has gained traction, drawing increasing interest from researchers and practitioners alike (Yu et al., 2023). Urban residents, grappling with the stresses of modern city life, are turning to agricultural ecotourism as a means to reconnect with nature and savor the unhurried pace of rural living (Zhou, 2024). This growing inclination towards agricultural ecotourism reflects the evolving landscape of tourism development and management, catering to the demands of new rural construction by introducing agricultural tourism as a novel and appealing option for travelers (Guo et al., 2024). By melding the key components of agricultural ecotourism resources, this emerging sector presents a fusion of agricultural tourism and ecotourism, tailored to meet the changing preferences of the market (Wang et al., 2023).

The concept of agricultural tourism has a longstanding history, with developed European nations championing its virtues since the 1930s, underscoring its instrumental role in bolstering rural

DOI: 10.4018/IJCINI.356919

economies (Zhang et al., 2023). Over time, agricultural ecotourism has evolved into a prominent tourism model, offering enriching experiences that resonate with visitors (Yang et al., 2023). Scholars have underscored the importance of integrating rural cultural traditions with the natural environment to authentically showcase the distinctive charm of rural life and allure tourists seeking unique experiences (Song et al., 2023). In China, academics have been actively engaged in the study of agricultural ecotourism, conducting assessments of tourism resources, analyzing the current landscape and trends in agricultural ecotourism development, and outlining essential principles for the planning and management of agricultural ecotourism areas, considering their socioeconomic repercussions (Wang & Tian, 2023). Experts advocate for the utilization of various analytical techniques, such as factor analysis and fuzzy comprehensive evaluation, to refine the accuracy and reliability of evaluation outcomes, thereby enhancing the efficacy of decision-making processes in this dynamic field (Wu et al., 2023).

The innovations of this paper are as follows: This paper focuses on the Grand Canyon scenic area of Taihang Mountains as the primary research object, conducting a comprehensive analysis of the current state of agricultural ecotourism in China. It establishes an evaluation index system for agricultural ecotourism resources based on the fuzzy comprehensive evaluation method, comprising eight indices in the index layer and three indices in the evaluation index layer, forming a holistic evaluation system for agricultural ecotourism resources. By calculating the weight of each index in the system, this study uses it as a crucial indicator to assess the agricultural ecotourism resources in the Grand Canyon scenic area of Taihang Mountains. The findings of this paper are expected to provide valuable guidance for the development and planning of agricultural ecotourism in this region, contributing to the enrichment of the theoretical framework surrounding agricultural ecotourism resources.

RELATED WORK

The evaluation of eco-tourism resources hinges on emphasizing the distinct attributes of *eco-tourism resources* and *eco-tourism activities*. When selecting the indicators, greater consideration should be given to the distinctions between the resource types and activity modes of eco-tourism compared to other forms of tourism. This evaluation constitutes a complex system engineering endeavor, encompassing various methods for obtaining diverse indicators, including cost-benefit analysis, the travel cost method, the conditional value method, the analytic hierarchy process (AHP), and the fuzzy comprehensive evaluation method (Yi et al., 2023).

At present, there are relatively few studies on the evaluation of eco-tourism resources. Etemad et al. (2024) used the theory of fuzzy comprehensive evaluation to construct the system of core competition index assessment. From the angles of quantitative analysis and qualitative analysis, they made a comprehensive evaluation on the hospitality's core competition, providing a theoretical basis for the effective management strategies and promoting sustainable development power. Evaluating the development engineering value of lake tourism resources has become an important part of lake tourism. It is foundational for lake tourism development, and it is also a level measurement for the development potential of lake tourism resources.

On the basis of the full definition of *lake tourism* and *lake tourism resource* and the characteristics of lake tourism resource, Baral and Saini (2024) constructed an evaluation index system of development engineering value of lake tourism resource, using approaches such as the Delphi method, AHP, and the fuzzy comprehensive evaluation method, which contains 24 specific indices then determines the weighting of each index quantitatively. Only quantitative analysis and systematic evaluation of tourism resources can measure tourism resources value comprehensively (Zeng et al., 2013), thus making accurate target market actively seeking the sustainable and unique ways of development, authentically satisfy the requirements of the ecotourism development. Zeng et al. (2013) integrated lake tourism resources characteristics using the Delphi method, AHP, and the fuzzy comprehensive evaluation

method, constructed a system and model of the lake tourism resource development engineering evaluation, and developed a theory of tourism resource value evaluation. Sun et al. (2014) established an evaluation index system of red tourism resources. They estimated the weights of each indicator using AHP and evaluated red tourism resources with fuzzy comprehensive evaluation.

Holistic tourism, as a new model of boosting regional competitiveness, can be applied in the concentration areas of tourism resources, led by the tourism industry, target for optimizing the resource and regional economic development. Ma et al. (2018) aimed to build a comprehensive assessment model of holistic tourism resources based on fuzzy mathematical theory and comprehensive analytical methods and analyses the tourism resources with the case study of Qionghai City, Hainan Province. Zhao and Guo (2022) constructed an evaluation index system of red tourism resources in the Dabie Mountain area from three dimensions: the value of the red tourism resources, the conditions of the scenic spots, and tourism development conditions. Zhao and Guo (2022) evaluated the resources of three red tourism scenic spots by using fuzzy comprehensive assessment method, and the three red tourism scenic locations are Hong'an Martyrs Cemetery, Macheng Martyrs Cemetery, and Macheng Horse Hall in Huanggang City.

Hu et al. (2018) showed the objective and correct evaluation of red tourism resources and evaluated each object synthetically fuzzy comprehensive evaluation method and AHP. Based on the balanced score card, Zheng et al. (2022) aimed to build a system of performance evaluation indicators custom-tailored to the eco-cultural tourism development in Fujian Province from four aspects, namely, financial performance, public benefits, internal process, and learning and growth. Judging from the fuzzy comprehensive evaluation, the effects were found to be at the average level for the eco-cultural tourism development in Fujian Province, scoring between 60 and 74.

Wei et al. (2014) delved into the realm of tourism resource engineering in the context of the XingWen Geo-Park, shedding light on the exploration and assessment of the tourism resources in this geologically significant area, aiming to provide valuable insights into optimizing the utilization and management of these resources for sustainable tourism development. Lian et al. (2017) delved into the assessment of tourism websites using a novel approach based on triangular intuitionistic fuzzy multiple attribute group decision making (TIFMAGDM). This research aims to provide a comprehensive framework for evaluating the performance and effectiveness of tourism websites, considering the complex and dynamic nature of online platforms in the tourism industry.

CURRENT SITUATION OF ECO-AGRICULTURAL TOURISM

In the past decade, agricultural tourism in China has experienced rapid development. Certain regions have transitioned from traditional rural areas to embracing agricultural eco-tourism (Yi et al., 2023). The typical representatives are Sun Qiao in Shanghai and private villages in Beijing. Agro-eco-tourism is an amalgamation of eco-tourism and eco-agriculture, which brings about fundamental changes to traditional agricultural practices by promoting ecological restoration and protection (Peng & Zhang, 2023). It also addresses the challenges associated with new rural development and social–economic progress (Sau-Wa Mak, 2024). Through an examination of gross domestic product (GDP) trends (Figure 1), tourist numbers (Figure 2), and total tourism expenditure (Figure 3) between 2010 and 2019, along with an analysis of the expenditure patterns of urban and rural residents, it can be concluded that as GDP rises, the number of tourists in China also increases. Furthermore, the growth rate of tourism expenditure remains consistent for both urban and rural residents. Table 1 presents the per capita travel expenditure of China from 2010 to 2019.

Figure 1. GDP from 2010 to 2019

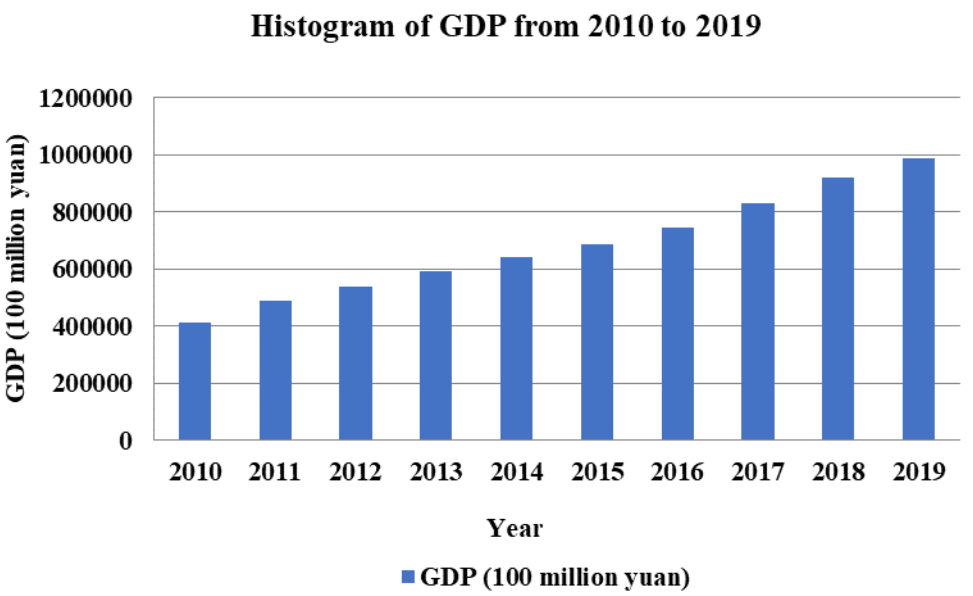
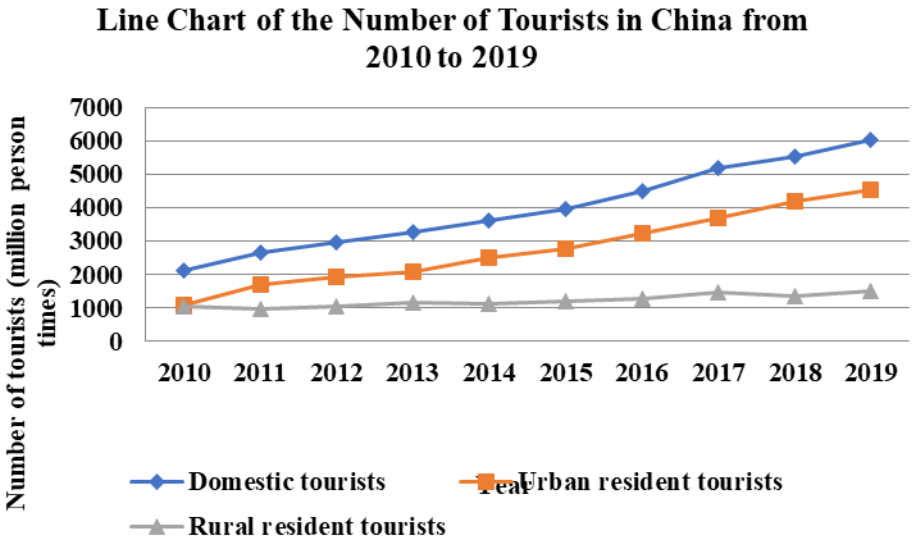


Figure 2. Total number of tourists and urban and rural residents in China from 2010 to 2019



EVALUATION AND DESIGN MODEL OF AGRO-ECO-TOURISM RESOURCES BASED ON FUZZY ALGORITHMS

Fuzzy Evaluation

This paper uses the most popular comprehensive evaluation method in the market during the research period. This method is the fuzzy comprehensive evaluation method. The basic principle is to use fuzzy mathematics to comprehensively evaluate the objects or things that are restricted

Table 1. Travel expenditures per capita in China from 2010 to 2019

Year	Tourism cost per capita (yuan)	Urban residents	Rural residents
2010	602.4	829.6.	375.2.
2011	746.4	865.3.	617.8.
2012	771.2	924.6.	626.8.
2013	812.2	976.4.	648.
2014	841.5	969.3.	713.7.
2015	856.9	978.2.	735.6.
2016	889.1	1011.3.	766.9.
2017	921.7	1031.4.	812.
2018	924.6	1025.7.	823.5.
2019	954.2	1059.8.	848.6.

by many factors (Son et al., 2023). The following is the process of using the fuzzy comprehensive evaluation method.

1. Assume P as the object of evaluation.
2. Three indicators were selected for evaluation: ecological resource value (B_1), ecological environment condition (B_2), and tourism development condition (B_3).
3. Establish evaluation index set $U = \{u_1, u_2, ..., u_m\}$ and analyze and build the evaluation index set according to evaluation criteria of agricultural eco-tourism resources.

Figure 3. Total travel expenses and travel expenses of urban and rural residents in China from 2010 to 2019

4. Create evaluation index weight set $A = (a_1, a_2, ..., a_m)$. The importance of different indicators in the index set varies, so each indicator should be given weight to judge the importance of indicators according to the weight.
5. Establish the set of evaluation levels $V = \{v_1, v_2, ..., v_m\}$, with each level corresponding to the fuzzy subset.
6. Construct the fuzzy relation matrix R. By making a fuzzy evaluation of each element in U according to the grade index in the evaluation set, the following evaluation matrix can be obtained:

$$R = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1m} \\ r_{21} & r_{22} & \cdots & r_{2m} \\ \cdots & \cdots & \cdots & \cdots \\ r_{n1} & r_{n2} & \cdots & r_{nm} \end{bmatrix} \tag{1}$$

where R_{ji} represents the membership between v_j and u_i, i.e., the evaluation of each evaluation index.

7. Compute the fuzzy comprehensive evaluation set as in Equation 2.

$$A \circ R = (a_1, a_2, ..., a_m) \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1m} \\ r_{21} & r_{22} & \cdots & r_{2m} \\ \cdots & \cdots & \cdots & \cdots \\ r_{n1} & r_{n2} & \cdots & r_{nm} \end{bmatrix} = (b_1, b_2, ..., b_m) = B \tag{2}$$

After normalization, the evaluation level of object P can be determined, that is, the comprehensive score of agricultural eco-tourism resources. Finally, the result vector of fuzzy comprehensive evaluation is further analyzed.

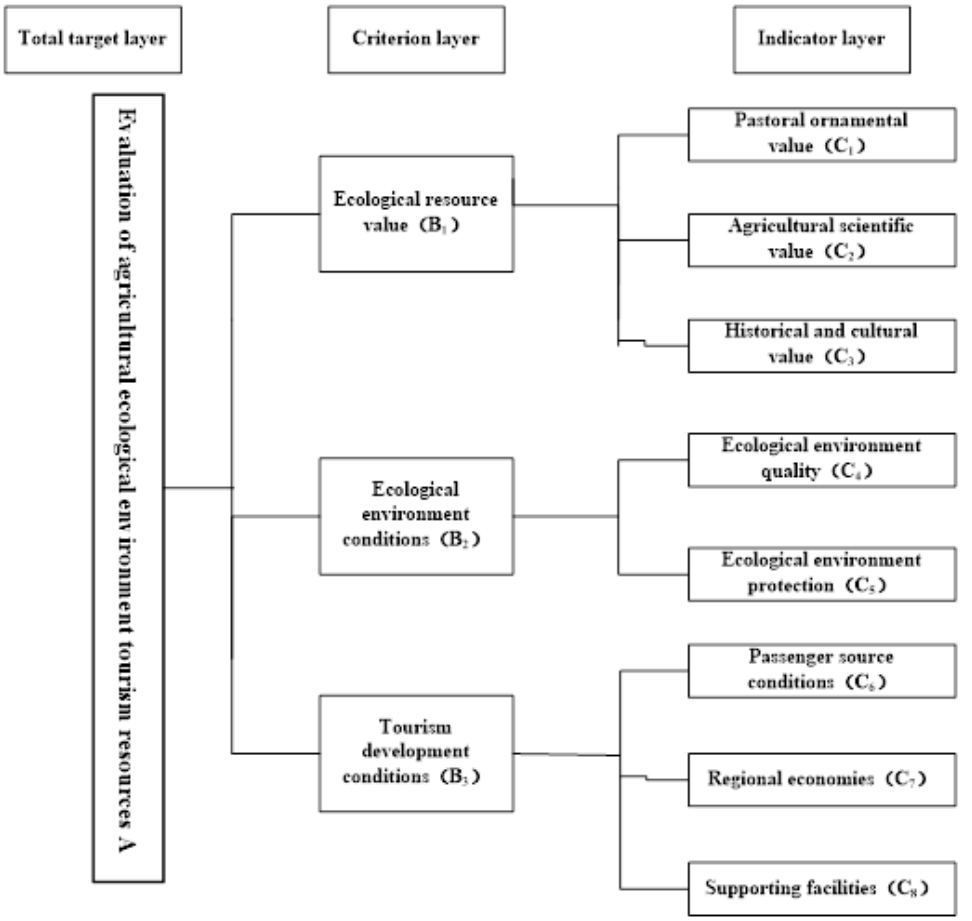
Construction of Evaluation Index System for Agro-Eco-Tourism Resources

This paper establishes the evaluation index system of agricultural eco-tourism resources based on the process of tourism resource management and the theory of financial management. The term A is the overall target level, that is, the evaluation of agricultural eco-environmental tourism resources, and B is the criterion level. The main indicators are ecological resource value (B_1), ecological environment condition (B_2), tourism development condition (B_3), and C is the index level. The main indicators include idyllic ornamental value (C_1), agricultural scientific value (C_2), historical and cultural value (C_3), ecological environment quality (C_4), ecological environment protection (C_5), guest source condition (C_6), and so on. Regional economy (C_7), supporting facilities (C_8), Figure 4 presents the evaluation index system of agricultural eco-tourism resources built in this paper.

Establishing a Comprehensive Evaluation Model of Agricultural Eco-Tourism Resources

Based on the fuzzy comprehensive evaluation method in fuzzy mathematics, the comprehensive evaluation value of eco-tourism resources is calculated by using the weighted sum and multi-index comprehensive evaluation model. First, the C-layer in the evaluation index system is considered as the set of comprehensive evaluation factors, $C = \{C_1, C_2, \ldots, C_m\}$. Second is to make each index value clear. Most of the indices in this system can be obtained or calculated from the statistics of tourism resources. Third, $B_i = (1, 2, \ldots, n)$ is the weight corresponding to u_i, and weight set $W = \{W_1, W_2, \ldots, W_m\}$ is constructed.

Figure 4. Architecture model of agro-eco-tourism resource evaluation



Finally, the comprehensive evaluation value of agro-eco-tourism can be calculated by progressively substituting the weights and scores in the following weighted sum and multi-index comprehensive evaluation models.

$$E = \sum_{h=1}^{P}\left[\sum_{j=1}^{m}\left(\sum_{i=1}^{n}A_i B_i\right)Cjh\right] \tag{3}$$

where E is the total score of each index; A_i represents the score of the third-tier individual indicator; B_i denotes the weight given by the third level of the index; C_j represents the jth second hierarchical index weight; D_h denotes the weight of the first index level in the h; n represents the number of indicators at Level 3; m is the number of indicators at Level 2; and p denotes the number of Level 1 indicators.

Table 2. Index weight of agro-eco-tourism resources

Target layer (A)	Criterion layer	Weight	Indicator layer	Weight
General objective of agricultural eco-tourism resources evaluation	Ecological resource value (B_1)	0.49	Rural ornamental value (C_1)	0.167
			Agricultural science value ($C2$)	0.126
			Historical and cultural value (C_3)	0.101
	Ecological environment conditions (B_2)	0.36	Ecological environment quality (C_4)	0.194
			Ecological environment protection (C_5)	0.159
	Tourism development conditions (B_3)	0.15	Passenger source conditions (C_6)	0.112
			Regional economy (C_7)	0.083
			Supporting facilities (C_8)	0.058

RESULTS AND ANALYSIS

Weight Results of Indicators of Agro-Eco-Tourism Resources

The Grand Canyon scenic area of Taihang Mountains was the main research object in the process of studying agricultural eco-tourism resources. This area is the most representative rural tourism scenic area in China, which is located in the southeast of Huguan County, Changzhi City, Shanxi Province, with an area of 225 km^2. High in the north end and low in the south, posters exceed 1,200 m in most areas. There are about 180 natural villages and 13,000 people in the scenic area. More than 300 species of rare plants are planted in the canyon gardens, among which Taxus chinensis is of high research value. Table 1 lists basic data on the Grand Canyon scenic area in Taihang Mountains. Huguan County received 46.113 million tourists from home and abroad in 2019, an increase of 41.9% compared with the previous year, and its tourism revenue reached 4.411 billion yuan, an increase of 17.22% compared with the previous year. Travel revenue in China was 4.353 billion yuan, up by 21.2%. Overseas travel revenue of 9.163 million US dollars decreased by 54.2%. Based on the fuzzy comprehensive evaluation method given above, the comprehensive weights of the index system of agricultural eco-tourism resources and the weights of each index are calculated and listed in Table 2.

The data from the table above shows that the highest weight in the criterion layer is ecological resource value (B_1), with a weight of 0.49, followed by ecological environment condition (B_2), a weight of 0.36, and the lowest weight is tourism development condition (B_3), with a weight of 0.15. The B_1 and B_2 represent 85% of the total. This is the main body for constructing the evaluation index system of agricultural eco-tourism resources.

The weight of each index in the index layer, such as ornamental value (C_1), scientific value of agriculture (C_2), historical and cultural value (C_3), ecological environment quality (C_4), ecological environment protection (C_5), and passenger source condition (C_6), all exceed 0.1, indicating that these indices have a greater impact on the agricultural ecological environment resources in this area, and are also important indicators for the evaluation of agricultural ecological environment resources. The highest weight is the ecological environment quality (C_4), and the value is 0.194. Therefore, the importance of the ecological environment quality to the development of agricultural eco-tourism in a region can be seen. The lowest weight is the supporting facilities (C_8), which has a value of 0.058. This index is directly related to regional economic development and belongs to external facilities. It should also be paid attention to when evaluating agricultural eco-tourism resources. Figure 5 presents a line chart of the score index of the evaluation of ecological agriculture development in the Grand Canyon scenic area of Taihang Mountains from 2010 to 2019.

Figure 5 shows that the agricultural ecology development in the Grand Canyon scenic area of Taihang Mountains has been continuously increasing from 2010 to 2019, from 0.46 in 2010 to 0.99 in 2019, indicating that the current situation of agricultural ecology in this area has been fully improved.

Table 3. Comprehensive evaluation criteria for agro-eco-tourism resources

Grade	I	II	III	IV	V
Score	[90,100]	[80,90)	[70,80)	[60,70)	[0,60)

Evaluation Results of Agro-Eco-Tourism Resources

This paper combines the comprehensive score of agricultural eco-tourism resources with the national classification standard of tourism resources and divides the comprehensive evaluation standard into five levels. The Grade I score interval is [90,100], which indicates that the region is rich in agricultural eco-tourism resources and is suitable for developing agricultural eco-tourism. The Grade II scoring range is [80,90], indicating that the agricultural eco-tourism resources in this region are relatively rich, have certain ornamental value, and have good ecological environment quality. The Grade III scoring range is [70,80), indicating that the agricultural eco-tourism resources in this region are general, and can carry out eco-tourism with local characteristics in accordance with the actual conditions of the region; the Grade IV scoring range is [60,70), indicating that the region is relatively scarce in agricultural eco-tourism resources, and some areas can be selected to develop agricultural eco-tourism resources; the Grade V scoring range is [0,60), indicating that there are very few agricultural eco-tourism resources in this region, so it is not recommended to develop agricultural eco-tourism.

Based on the evaluation model of agricultural eco-tourism resources established above and combined with the weight of each index obtained above, the evaluation results of agricultural eco-tourism resources were calculated using Equation 2. Table 3 lists the specific scores.

According to the data in the table above, the comprehensive evaluation score of the Grand Canyon scenic area in Taihang Mountains is 82.875, indicating Level IV ecological resources. It has abundant ecological resources and is suitable for developing agricultural eco-tourism projects. The values of ecological resources (B_1), ecological environment conditions (B_2), and tourism development

Figure 5. Evaluation score index of eco-agriculture development in Grand Canyon scenic area of Taihang mountains 2010–2019

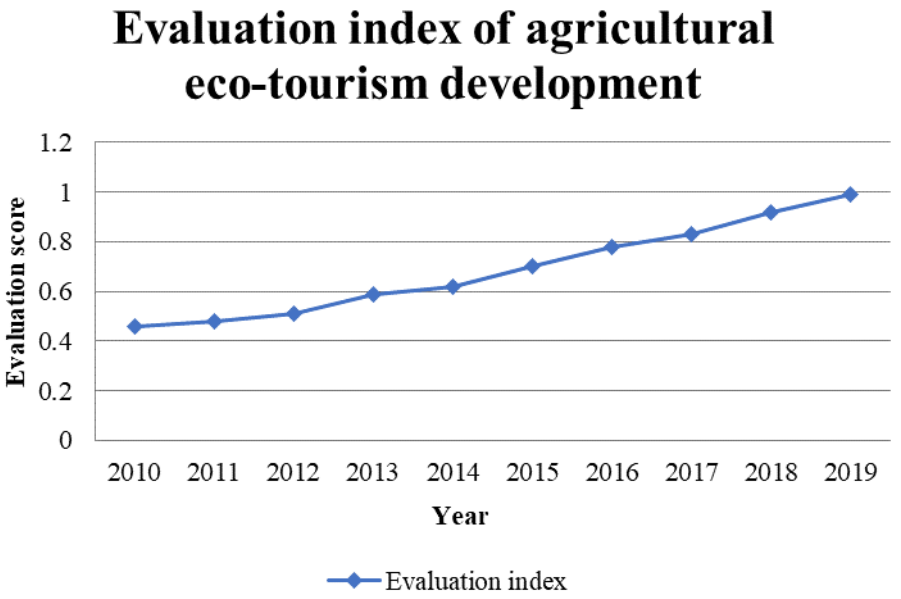


Table 4. Scoring of indicators of agro-eco-tourism resources

Target layer (A)	Score	Criterion layer (B)	Score	Index layer (C)	Score
General target of evaluation of agricultural eco-tourism resources	82.875	Value of ecological resources (B_1)	42.96	Rural ornamental value (C_1)	90
				Agricultural science value (C_2)	85
				Historical and cultural value (C_3)	68
		Ecological environment conditions (B_2)	34.72	Ecological environment quality (C_4)	85
				Ecological environment protection (C_5)	84
		Conditions for tourism development (B_3)	22.32	Passenger source conditions (C_6)	83
				Regional economy (C_7)	87
				Supporting facilities (C_8)	81

conditions (B_3) in the criteria layer are 42.96, 34.72, and 22.32, respectively, with the highest score being B_1, indicating that the value of agricultural eco-tourism resources in the scenic area of Taihang Mountain Grand Canyon is high and contributes to the local economic development. The second is B_2, with a score of 34.72. This index accounts for a large proportion of the total score, indicating that the eco-environment in this area is comfortable, stable and of high quality. The development of this area and the eco-environment are in a balanced state. Layer B_3 has a score of 22.32, which is the lowest among the three indicators. This is due to the lack of sufficient supporting facilities and underdeveloped economy in this area, which has restrained the development of agricultural eco-tourism.

In summary, this paper establishes an evaluation model of agricultural eco-tourism resources based on the fuzzy comprehensive evaluation method to evaluate the Grand Canyon scenic area of Taihang Mountains. The results show that the scenic area has ideal environmental conditions, conforms to the concept of sustainable ecological environment development, has good guest source conditions, and has higher values of idyllic and agricultural science. However, there are no relevant supporting facilities in the process of developing agricultural eco-tourism in this area. It also does not make full use of the historical and cultural value, thus restricting the rapid development of agricultural eco-tourism in this region.

CONCLUSION

In this paper, the current situation of agricultural eco-tourism in China is briefly introduced in the process of evaluating agricultural eco-tourism resources, and the GDP, number of tourists, total tourism expenditure and per capita tourism expenditure from 2010 to 2019 are analyzed. It is concluded that the tourism industry in China has been increasing continuously during this period, while the number of tourists of town residents is growing faster and more than that of rural residents. The growth trend of urban and rural resident travel expenditure is the same, and the per capita travel expenditure is also increasing continuously, and the total of per-capita travel expenditures of urban residents is higher than that of rural residents.

This study established an evaluation index set, evaluation index weight set, and evaluation grade set by fuzzy comprehensive evaluation method, and establishes evaluation index system of agricultural eco-tourism resources on this basis. The system consists of three parts: target layer (A), criterion layer (B), and index layer (C). The main indices in criterion layer are ecological resource value (B_1), ecological environment condition (B_2), and tourism development condition (B_3). Indicators in the index layer include ornamental value (C_1), scientific value of agriculture (C_2), historical and cultural value (C_3), ecological environment quality (C_4), ecological environment protection (C_5), source conditions (C_6), regional economy (C_7), supporting facilities (C_8). Based on this, a comprehensive

evaluation model of agricultural eco-tourism resources is established. The Grand Canyon scenic area of Taihang Mountains is a typical representative of agro-eco-tourism. Calculating the index weights of the evaluation index system of agro-eco-tourism resources according to the fuzzy comprehensive evaluation method, the highest weight of the criterion layer is B_1, with a value of 0.49. The highest weight of index layer is C_4 with a weight of 0.194, which indicates that the value of ecological resources and the quality of ecological environment are important indicators for the evaluation of agricultural eco-tourism resources and have a direct impact on the evaluation results. The weight of each index is substituted into the established evaluation model of agricultural eco-tourism resources. The comprehensive evaluation is a score of 82.875, and the ecological resources are of Grade IV. It shows that the region is rich in ecological resources and is the best area for developing agricultural eco-tourism.

DATA AVAILABILITY

The figures and tables used to support the findings of this study are included in the article.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest.

FUNDING STATEMENT

This work was supported by the 2022 Henan Province philosophy and social science planning project "Research on the Government Empowerment Mechanism to Improve the Livelihood of Farmers in Rural Tourism Areas in Henan Province" phased research results (No. 2022BJJ093).

PROCESS DATES

September 16, 2024
Received: April 29, 2024, Revision: August 19, 2024, Accepted: August 19, 2024

CORRESPONDING AUTHOR

Correspondence should be addressed to Chunying Xu (China, icecreamyyz@163.com)

REFERENCE

Baral, R., & Saini, V. K. (2024). Nepalese tourism from the lens of residents: An assessment of impact perception, attitude, and action towards tourism development in Gandaki province, Nepal. *Tourism and Hospitality Research*, 14673584241232850. DOI: 10.1177/14673584241232850

Etemad, A., Shafaat, A., & Bahman, A. M. (2024). A comprehensive review and sensitivity analysis of the factors affecting the performance of buildings equipped with variable refrigerant flow system in Middle East climates. *Renewable & Sustainable Energy Reviews*, *191*, 114131. DOI: 10.1016/j.rser.2023.114131

Guo, J., Rong, Y., Zhu, J., Yan, Y., Du, J., Zheng, L., & Zhao, Y. (2024). Industrial development zoning with dual objectives of spatial development suitability and ecosystem service value a case study in Xiaonanhai Hydropower Station basin. *Ecological Indicators*, *158*, 111522. DOI: 10.1016/j.ecolind.2023.111522

Hu, R., & Zhang, C. (2018). An empirical study on fuzzy comprehensive evaluation of red tourism resources based on AHP. *Applied Mathematics*, *9*(2), 171–177. DOI: 10.4236/am.2018.92012

Lian, T., Yu, C., Wang, Z., & Hou, Z. (2017). The evaluation study on tourism websites: From the perspective of triangular intuitionistic fuzzy multiple attribute group decision making. *Journal of Applied Statistics*, *44*(16), 2877–2889. DOI: 10.1080/02664763.2016.1266466

Ma, J., Sun, G. N., & Ma, S. Q. (2018). Assessing holistic tourism resources based on fuzzy evaluation method: A case study of Hainan tourism island. In *Fuzzy Information and Engineering and Decision* (pp. 434–446). Springer International Publishing. DOI: 10.1007/978-3-319-66514-6_43

Peng, Q., & Zhang, B. (2023). Protection of agricultural cultural heritage: A new opportunity for the development of ecological agriculture. *Academic Journal of Agricultural Sciences*, *4*(1). Advance online publication. DOI: 10.38007/AJAS.2023.040101

Sau-Wa Mak, V. (2024). Scientists and remaking heritage: The case of shiitake cultivation in a globally important agricultural heritage system in Japan. *International Journal of Heritage Studies*, *30*(1), 42–55. DOI: 10.1080/13527258.2023.2272255

Son, N. N., Thu, N. T. P., Dung, N. Q., Huyen, B. T. T., & Xuan, V. N. (2023). Determinants of the sustained development of the night-time economy: The case of Hanoi, capital of Vietnam. *Journal of Risk and Financial Management*, *16*(8), 351. DOI: 10.3390/jrfm16080351

Song, S., Yu, H., Zhang, Q., Zhang, L., Zhong, Q., & Zhang, G. (2023). Functional regionalization of land resources considering eco-efficiency in Nanjing Metropolitan Area, China. *Ecological Indicators*, *155*, 110964. DOI: 10.1016/j.ecolind.2023.110964

Sun, Z., & Tan, Y. (2014, June). Evaluation and development strategy of red tourism resources. *Proceedings of the 2014 11th International Conference on Service Systems and Service Management* (pp. 1–4). IEEE.

Wang, J., Yin, H., Jin, J., & Cui, L. (2023). Methods of improving rural water ecological environment and promoting the development of ecological economy from the perspective of the digital economy. *Water Science and Technology: Water Supply*, *23*(5), 2162–2174. DOI: 10.2166/ws.2023.103

Wang, Y., & Tian, R. (2023). Development of rural regions in China: Evidence of industry integration by the residents of Yongan Village (Quanzhou City, China). *Sustainability (Basel)*, *15*(4), 2928. DOI: 10.3390/su15042928

Wei, Y. L., Guo, S. L., Zhao, S., & Li, D. X. (2014). Exploration and evaluation of tourism resources engineering for XingWen Geo-Park. *Applied Mechanics and Materials*, *668*, 1667–1670. DOI: 10.4028/www.scientific.net/AMM.668-669.1667

Wu, Y., Sun, Y., Zhou, C., Li, Y., Wang, X., & Yu, H. (2023). Spatial–temporal characteristics of carbon emissions in mixed-use villages: A Sustainable development study of the Yangtze River Delta, China. *Sustainability*, *15*(20), 15060. DOI: 10.3390/su152015060

Yang, B., Zhang, Y., Xiong, K., Huang, H., & Yang, Y. (2023). A review of eco-product value realization and eco-industry with enlightenment toward the forest ecosystem services in Karst Ecological Restoration. *Forests*, *14*(4), 729. DOI: 10.3390/f14040729

Yi, S., Zhou, Y., Zhang, J., Li, Q., Liu, Y., Guo, Y., & Chen, Y. (2023). Spatial–temporal evolution and motivation of ecological vulnerability based on RSEI and GEE in the Jianghan Plain from 2000 to 2020. *Frontiers in Environmental Science*, *11*, 1191532. DOI: 10.3389/fenvs.2023.1191532

Yu, S., Yang, L., Song, Z., Li, W., Ye, Y., & Liu, B. (2023). Measurement of land ecological security in the middle and lower reaches of the Yangtze River Base on the PSR Model. *Sustainability (Basel)*, *15*(19), 14098. DOI: 10.3390/su151914098

Zeng, Y., & Bao, X. P. (2013). A quantitative analysis of lake tourism resource value Based on AHP–fuzzy comprehensive evaluation method. *Advanced Materials Research*, *683*, 809–814. DOI: 10.4028/www.scientific.net/AMR.683.809

Zhang, P., Wu, L., & Li, R. (2023). Development drivers of rural summer health tourism for the urban elderly: A demand-and supply-based framework. *Sustainability (Basel)*, *15*(13), 10686. DOI: 10.3390/su151310686

Zhao, J., & Guo, H. (2022). Spatial and temporal evolution of tourism ecological security in the old revolutionary region of the Dabie Mountains from 2001 to 2020. *Sustainability (Basel)*, *14*(17), 10762. DOI: 10.3390/su141710762

Zheng, Q., Chen, Q., & Kong, D. (2022). Performance evaluation of the development of eco-cultural tourism in Fujian Province based on the method of fuzzy comprehensive evaluation. *Frontiers in Environmental Science*, *10*, 1022349. DOI: 10.3389/fenvs.2022.1022349

Zhou, D. (2023, November). The influence of ecological agriculture tourism on rural ecological ethics based on the BPNN model. *Proceedings of the 2023 Third International Conference on Digital Data Processing* (pp. 216–221). IEEE. DOI: 10.1109/DDP60485.2023.00049

Zhou, Y. (2024). Influence of the integration of digital art elements in ecological environment on tourist acceptance. *Computer-Aided Design and Applications*, *21*(S2), 157–170.