

Efficiency Evaluation and Enhancement Path of Sports Tourism in the Chengdu-Chongqing Economic Circle: An Empirical Study Based on the DEA-Tobit Model

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Abstract: Drawing on 2023 sports tourism data, this study employs the DEA-Tobit model to evaluate the efficiency of 18 sports tourism destinations within the Chengdu-Chongqing Economic Circle and investigates the primary factors influencing economic performance. The findings reveal that: (1) The overall efficiency of sports tourism in the Chengdu-Chongqing Economic Circle is relatively high. Pure technical efficiency significantly exceeds overall efficiency, indicating a mature level of management and production technologies. The average scale efficiency is close to the pure technical efficiency; however, only 44.4% of decision-making units (DMUs) operate at optimal scale, primarily due to mismatches between input and output sizes. (2) The most prominent positive driver of efficiency is per capita GDP. Location advantage exhibits a double-edged impact on management efficiency, while traditional explanatory variables such as scenic spot rating and climatic conditions demonstrate limited explanatory power.

Keywords: Chengdu-Chongqing Economic Circle; Sports Tourism; Economic Efficiency; DEA

1. Introduction

Sports tourism refers to travel activities where tourists leave their place of residence for an extended period, primarily for tourism and sports. Motivations mainly include leisure, entertainment, fitness, and adventure, with activities typically involving watching, appreciating, or participating in sports events. According to the National Bureau of Statistics, China's GDP reached 134.9 trillion yuan in 2024, with the added value of domestic tourism and related industries totaling 5.75 trillion yuan—a year-on-year increase of 17.1%.

The Chengdu-Chongqing Economic Circle Development Plan Outline explicitly calls for accelerating the development of an internationally influential economic zone. Guided by this policy, cooperation between Chengdu and Chongqing has deepened in infrastructure, cultural tourism, and ecological protection—particularly in sports tourism, which now possesses a robust foundation for growth. The region, located in the east-central part of Sichuan Province, features parallel ridge-valley landforms formed by over 20 fold-anticlinal mountain ranges, with elevations ranging from 700 to 1,000 meters. Notable tourist destinations include Mount Emei, Mount Qingcheng, Tiantai Mountain, Bifeng Gorge, and Baoding Peak of Mount Min. These sites provide ideal locations for mountain climbing, rock climbing, outdoor exploration, winter skiing, and grass skiing in spring and autumn. The region is rich in water resources, with the Yangtze River traversing it. Tributaries such as the Min, Tuo, Jialing, and Wu Rivers contribute to a total of 1,419 rivers and nearly 1,000 natural lakes. Among these, 22 rivers have drainage areas exceeding 1,000 km², making the region ideal for water sports including rafting, surfing, fishing, swimming, and boating. Notably, in 1999, National Geographic ranked a Yangtze River rafting expedition among the 25 most attractive journeys of the 21st century.

Regarding sports infrastructure, the region boasts over 353,500 sports venues—125,000 standard and 228,500 non-standard—covering a total area of 225 million square meters. Among these, 25

venues are capable of hosting provincial, national, and even international competitions. Between 2010 and 2024, the region hosted 60 international events and 150 national-level competitions, which not only enhanced global recognition but also enriched the sports tourism experience.

Sports tourism not only contributes to regional economic development but also strengthens public health and enhances urban reputation and visibility. In 2024, the total output of the sports industry in the Chengdu-Chongqing Economic Circle amounted to 265.25 billion yuan, with an added value of 100.02 billion yuan, representing 1.22% of the region's gross domestic product (GDP) for the same period. As a key economic growth pole in western China, the Chengdu-Chongqing Economic Circle holds substantial development potential in its sports tourism sector.

As a resource-intensive industry, the development of sports tourism depends not only on natural resources and infrastructure investment but also on technological innovation, market demand, policy conditions, and other structural factors. Therefore, evaluating the economic efficiency of sports tourism in the Chengdu-Chongqing Economic Circle and analyzing its influencing factors is of considerable practical significance for improving regional economic performance and optimizing resource allocation.

This study follows a two-stage empirical approach. In the first stage, the Slack-Based Measure Data Envelopment Analysis (SBM-DEA) model is applied to assess the economic efficiency of sports tourism in the Chengdu-Chongqing Economic Circle. In the second stage, the Tobit model is employed to identify key determinants and develop targeted policy recommendations.

2. Literature Review

2.1 Current Research Status

As an emerging cross-sector industry, sports tourism has attracted growing attention in academia. Research has primarily focused on market demand, industrial chain analysis, and benefit evaluation, while studies on economic efficiency remain relatively limited. Most studies utilize Input-Output Analysis or Stochastic Frontier Analysis (SFA). Wicker and Hallmann (2013) found that the economic benefits of sports tourism heavily depend on event scale and government support; however, their study was limited to single regions or specific events [1].

2.2 Application of the DEA Model

Data Envelopment Analysis (DEA), introduced by Charnes, Cooper, and Rhodes (1978), is widely applied in efficiency studies. Zhou, Ang, and Poh (2008) reviewed DEA's effectiveness in evaluating energy efficiency [2-3]. Barros (2005) [4] applied DEA to the tourism sector, providing a foundation for subsequent studies. Nevertheless, applications of DEA to regional sports tourism remain scarce [4].

2.3 Application of the Tobit Model

The Tobit model, developed by Tobin (1958), is appropriate for analyzing efficiency-related factors when the dependent variable is censored or truncated. Assaf and Josiassen (2012) applied the Tobit model to assess tourism firm performance, identifying both internal and external determinants [5-6]. Its application in sports tourism efficiency research remains nascent.

2.4 Domestic and International Research Review

International scholars have predominantly focused on economic impact evaluations of sports events, consumer behavior in tourism markets, and the integration of tourism industrial chains. Gibson (1998) noted that sports events significantly stimulate local economies [7]. Taks and Marijke (2013) emphasized that the short-term gains from mega-events outweigh their long-term effects [8].

In China, scholars have increasingly studied sports tourism efficiency. Ding Jing (2017) applied the DEA-BCC model to Gansu Province, revealing regional disparities in efficiency drivers [9]. Chen Yu and Yue Yousong (2024) analyzed 49 scenic spots using DEA and Tobit models, identifying efficiency imbalances, with eastern regions generally outperforming western regions [10].

However, few studies have specifically addressed the Chengdu-Chongqing Economic Circle, which this paper aims to explore.

3. Empirical Analysis

3.1 DEA Model Selection and Construction

The Data Envelopment Analysis (DEA) model assesses the relative efficiency of Decision Making Units (DMUs) by constructing a production possibility frontier. Classical models include the CCR model (Charnes, Cooper, and Rhodes), the BCC model (Banker, Charnes, and Cooper), and the Slack-Based Measure (SBM) model (Tone) [2;11-12]. The CCR and BCC models are based on radial distance functions, whereas the SBM model, as a non-radial distance function, is less sensitive to the measurement units of inputs and outputs, thereby producing more robust efficiency estimates. Accordingly, this study adopts the SBM-DEA model to evaluate the economic efficiency of sports tourism in the Chengdu-Chongqing Economic Circle.

3.1.1 DEA Model

Let the number of input variables X be m , and the number of output variables Y be s . Then, the corresponding production possibility set can be defined as follows:

$$P = \{(x, y) | x \geq \lambda X, y \leq \lambda Y, \lambda \geq 0\}$$

This study conducts efficiency analysis on the production set and establish the linear programming formulation of the SBM-DEA model:

$$\min_{\lambda, s^-, s^+} \rho = \frac{1 - \frac{1}{m} \sum_{i=1}^m \frac{s_i^-}{x_{i0}}}{1 + \frac{1}{s} \sum_{r=1}^s \frac{s_r^+}{y_{r0}}} \quad (1)$$

$$s. t. \quad x_0 = \lambda X + s^- \quad (2)$$

$$y_0 = \lambda Y - s^+ \quad (3)$$

$$\lambda \geq 0, s^- \geq 0, s^+ \geq 0 \quad (4)$$

Where ρ denotes the efficiency score (with $\rho = 1$ indicating full efficiency and $\rho < 1$ indicating inefficiency), x_0 and y_0 denote the input and desired output vectors, respectively, while X and Y represent the corresponding input and output matrices. λ is the intensity (weight) vector. s^+ and s^- denote the output and input slack variables for the k_{th} DMU.

3.1.2 Data

Owing to the unavailability of consistent statistical data—such as fixed asset investment, star-rated hotel inventory, number of employees, and tourist volume—across cities in the Chengdu-Chongqing Economic Circle, and due to frequent changes in statistical reporting standards between 2020 and 2025, this study restricts its sample to the 2023 list of national and provincial-level sports tourism demonstration bases. After eliminating duplicates, 18 unique scenic areas were identified, yielding 90 total observations. Indicator data were obtained from the official websites of scenic areas, 2023 annual reports of holding companies, and documents issued by official sports authorities. The efficiency analysis was conducted using the software MAXDEA.

3.1.3 Indicators

In constructing the DEA model, the 18 scenic areas are modeled as Decision-Making Units (DMUs), with each DMU representing a single site. Input indicators include labor input (number of employees), land input (total land area), and capital input (fixed asset investment) [13, 14-16]. Output indicators reflect both economic (tourism revenue) and social (visitor volume) outcomes [15, 17] as shown in Table 1.

Table 1: Evaluation System for Sports Tourism Economic Efficiency

Indicator Category	Primary Indicator	Secondary Indicator
Input Indicators	Labor Input	Number of Employees in Scenic Areas (persons)
	Land Input	Land Area (km ²)
	Capital Input	Fixed Asset Investment (billion RMB)
Output Indicators	Economic Output	Tourism Revenue (billion RMB)
	Social Benefits	Number of Tourists (10,000 person-visits)

Using MAXDEA software, the tourism efficiency of national and provincial-level sports tourism demonstration scenic areas in the Chengdu-Chongqing Economic Circle for the year 2023 was

calculated, as shown in Table 2. Among them, 8 scenic areas had a technical efficiency score of 1, indicating a 44.4% efficiency rate; 12 scenic areas achieved a pure technical efficiency score of 1 (66.7% efficiency rate); and 8 achieved a scale efficiency score of 1 (44.4%). The average scores for technical efficiency, pure technical efficiency, and scale efficiency were 0.69, 0.83, and 0.84, respectively. Eight scenic areas operated under constant returns to scale (CRS), six under increasing returns to scale (IRS), and two under decreasing returns to scale (DRS).

Table 2: Economic Efficiency of Sports Tourism in the Chengdu-Chongqing Economic Circle (2023)

DMU	Technical Efficiency	Pure Technical Efficiency	Scale Efficiency	Returns to Scale
1	1	1	1	Constant
2	1	1	1	Constant
3	1	1	1	Constant
4	1	1	1	Constant
5	0.55207	0.589582	0.936375	Decreasing
6	1	1	1	Constant
7	0.74609	1	0.74609	Increasing
8	1	1	1	Constant
9	0.15422	0.213895	0.721011	Increasing
10	0.327077	0.334909	0.976614	Near Constant
11	1	1	1	Constant
12	0.119215	1	0.119215	Increasing
13	0.601766	1	0.601766	Increasing
14	1	1	1	Constant
15	0.749733	0.7506	0.998845	Near Constant
16	0.310067	1	0.310067	Increasing
17	0.330991	0.445214	0.743443	Increasing
18	0.466868	0.517782	0.90167	Decreasing
Average	0.686561	0.82511	0.836394	—

Note: DMUs 1–18 refer to Xiling Snow Mountain, Longmenshan Jianjiang Valley (Pengzhou), Mount Emei, Guangwu Mountain (Bazhong), Xianhai Water Park (Mianyang), Changshou Lake (Chongqing), Chengdu Sunac Water Town, Luhua Water City, Bashan Grand Canyon (Dazhou), Longsheng New City (Chongqing), Hot Snow Miracle Resort (Chongqing), Nantian Lake Resort (Chongqing), Jindaoxia Scenic Area (Beibei), Huangshui Tourism Resort (Shizhu), Jinpo Mountain (Nanchuan), Hongkou Rafting (Dujiangyan), Baima Pass (Deyang), and Hanfeng Lake National Water Leisure Center (Chongqing).

From the distribution of returns to scale, 33.3% of DMUs operate under constant returns to scale, indicating that their production scale is already optimal. A further 38.9% show increasing returns to scale, suggesting that output efficiency can be improved through moderate expansion of input resources. Meanwhile, 11.1% of DMUs operate under decreasing returns to scale, indicating a need to guard against declining marginal returns due to overinvestment. DMUs 10 and 15 are near the boundary of constant returns to scale and should exercise caution in scaling strategies.

For DMUs with low overall efficiency, scale efficiency is generally below 0.75, but pure technical efficiency shows considerable variation. For instance, although DMU 12 has a scale efficiency of only 0.119, its pure technical efficiency is 1, indicating that inefficiency stems mainly from scale diseconomies. In contrast, DMU 9 demonstrates low scores in both pure technical efficiency (0.214) and scale efficiency (0.721), implying the need to optimize both technical management and scale structure. Some DMUs have effective pure technical efficiency but fail to reach optimal comprehensive efficiency due to insufficient scale efficiency, emphasizing that adjusting scale is key to improving overall performance.

The average comprehensive efficiency score in the Chengdu-Chongqing region exceeds the national average of 0.513, though its scale efficiency (0.836) remains slightly below the national average of 0.850. This suggests room for further optimization in scale management. Notably, only 15.38% of scenic areas nationwide are scale-efficient, compared to 44.4% in the Chengdu-Chongqing region, highlighting relatively better regional performance—though vigilance against scale inefficiency in certain areas remains necessary.

3.2 Tobit Model

3.2.1 Overview of the Tobit Model

The Tobit model is a type of regression model suitable for censored dependent variables—those

whose values are limited within a specific range. Since DEA efficiency scores are typically bounded between 0 and 1, they exhibit a censored distribution, making the Tobit model an appropriate choice for regression analysis in this context.

3.2.2 Model Construction

The Tobit model is formulated as follows:

$$y_i = \alpha_0 + \sum_{n=1}^N \beta_n x_i + \varepsilon_i \quad (5)$$

$$y_i = \alpha_0(u_i, v_i) + \sum_{n=1}^N \beta_n(u_i, v_i)x_i + \varepsilon_i \quad (6)$$

3.2.3 Indicators

In the Tobit regression model, the dependent variable y_i denotes the DEA efficiency score of scenic area i ; α_0 represents the intercept term; β_n denotes the regression coefficients corresponding to explanatory variables x_i ; and ε_i is the error term, assumed to be normally distributed with zero mean and constant variance: $\varepsilon_i \sim (0, \sigma^2)$.

The DEA efficiency scores calculated in the first stage are used as the dependent variable. The independent variables include five indicators in Table 3: scenic spot rating, annual average temperature, distance to the nearest central city (Chengdu or Chongqing), per capita GDP, and the proportion of the tertiary sector, based on previous studies [16, 18-25].

Table 3: Influencing Factors of Sports Tourism Efficiency in the Chengdu-Chongqing Economic Circle

Scenic Area	X1 (Rating)	X2 (Avg Temp °C)	X3 (Distance km)	X4 (GDP per capita)	X5 (Tertiary Industry Share)	Y (DEA Efficiency)
1	3	16.1	110	6.78	51.70%	1
2	2	15.7	95	8.42	32.20%	1
3	3	17.2	180	5.87	46.80%	1
4	3	18	450	2.95	52.40%	1
5	2	16.3	120	8.22	50.70%	0.936375
6	2	18.3	75	14	31.80%	1
7	1	16.5	68	7.12	64.40%	0.74609
8	2	17.1	22	24.1	75%	1
9	2	16.5	350	4.98	49.70%	0.721011
10	2	17.3	40	10.82	64.80%	0.976614
11	0	17.3	30	8.08	73.10%	1
12	2	18.2	180	7.46	47.20%	0.119215
13	2	15.5	70	9.29	51.50%	0.601766
14	0	16.3	230	5.96	53.60%	1
15	3	16.5	105	7.58	47.60%	0.998845
16	2	16.5	85	7.12	64.40%	0.310067
17	2	17.9	85	8.73	42.80%	0.743443
18	2	17.8	315	5.76	47.80%	0.90167

Note: X1–X5 represent scenic spot rating, annual average temperature, distance to regional core city, per capita GDP, and share of the tertiary sector, respectively. Y denotes the DEA efficiency score. X1 is coded as a dummy variable: 5A = 3, 4A = 2, 3A = 1.

Using Stata 17, the marginal effect of each explanatory variable is estimated on technical efficiency (TE), pure technical efficiency (PTE), and scale efficiency (SE). The results are shown in Table 4.

Table 4: Regression Results of Efficiency Influencing Factors

Variable	Technical Efficiency (TE)	Pure Technical Efficiency (PTE)	Scale Efficiency (SE)
X1	-0.0828	-0.1166	-0.0431
X2	-0.0894	-0.0758	-0.0639
X3	0.1233	-0.0474	0.1439
X4	0.2678	0.0956	0.2511
X5	-0.0799	0.0073	-0.0538
cons	0.8619	1.2469	0.9858

The results indicate:

1) Scenic Spot Rating: The coefficients of X1 are -0.083 for TE, -0.117 for PTE, and -0.043 for SE, none of which are statistically significant. This suggests that scenic rating has limited influence on economic efficiency. Tourists are more sensitive to experiential quality, availability of sports activities, and the completeness of facilities.

2) Climate Conditions: Average annual temperature shows no significant correlation with any efficiency dimension, implying limited explanatory power. This may be attributed to the region's complex topography, multi-layered climate zones, polycentric urban layout, and diverse tourist preferences.

3) Geographic Location: The distance variable (X3) is positively associated with TE and SE, but negatively with PTE, suggesting a heterogeneous impact. Proximity to central cities enhances overall and scale efficiency through better access to resources and aggregation of visitor flows.

4) Per Capita GDP: X4 exhibits significant positive relationships with TE (0.26) and SE (0.25), and a moderate positive association with PTE. This indicates that higher economic development levels correspond to more efficient allocation and utilization of sports tourism resources, facilitating economies of scale.

5) Tertiary Industry Share: X5 has weak correlations with efficiency indicators (-0.080 for TE, 0.007 for PTE, -0.054 for SE), suggesting that at this stage, the development of the tertiary sector has not substantially improved technical management or operational efficiency in scenic areas.

4. Conclusion and Policy Recommendations

4.1 Conclusion

This study employed the DEA-Tobit two-stage modeling approach to measure and analyze the economic efficiency of 18 sports tourism destinations in the Chengdu-Chongqing Economic Circle for the year 2023. The major findings are as follows:

The overall economic efficiency of sports tourism in the region is relatively high. Pure technical efficiency significantly surpasses scale efficiency, reflecting mature management and production technologies. The average scale efficiency approximates that of pure technical efficiency; however, only 44.4% of DMUs operate at optimal scale, mainly due to mismatches between input and output levels.

Per capita GDP emerged as the most important positive determinant of efficiency. Location advantage has a dual impact on management efficiency, while traditional factors such as scenic rating and climate conditions exhibit limited explanatory power.

4.2 Policy Recommendations

4.2.1 Improving Scale Efficiency

For DMUs with low pure technical efficiency, digital management tools and service innovations should be introduced to strengthen technical capabilities. DMUs with increasing returns to scale should appropriately expand input resources, while those experiencing decreasing returns should transition toward intensive development strategies and optimize resource allocation.

4.2.2 Enhancing Regional Integration

The government should strengthen coordinated development between Chengdu and Chongqing by leveraging the best practices of high-efficiency units. Promoting cross-regional resource sharing and complementarity can lead to overall Pareto improvements in efficiency.

4.2.3 Upgrading the Tertiary Sector

Refining the internal structure of the service sector by fostering technological and managerial innovation; Integrating sports tourism with high-value service industries rather than relying on low-efficiency traditional services; Moreover, preventing inefficiencies arising from disorganized, small-scale operations by promoting industrial clustering and scaling up operations.

4.3 Limitations and Future Research

The study is constrained by a limited sample size, which restricts a comprehensive assessment of spatial heterogeneity in sports tourism efficiency across the Chengdu-Chongqing Economic Circle. Future research could expand sample coverage using spatial sampling techniques and explore the interaction mechanisms among influencing variables. This would provide deeper theoretical and

practical insights for the high-quality development of regional sports tourism.

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References

- [1] Wicker P, Hallmann K, Breuer C. Analyzing the impact of sport infrastructure on sport participation using geo-coded data: Evidence from multi-level models [J]. *Sport management review*, 2013, 16(1): 54-67.
- [2] Charnes A, Cooper W W, Rhodes E. Measuring the efficiency of decision making units [J]. *European journal of operational research*, 1978, 2(6): 429-44.
- [3] Zhou P, Ang B W, Poh K L. A survey of data envelopment analysis in energy and environmental studies [J]. *European journal of operational research*, 2008, 189(1): 1-18.
- [4] BARROS C P. Measuring efficiency in the hotel sector [J]. *Annals of tourism research*, 2005, 32(2): 456-77.
- [5] Tobin J. Estimation of relationships for limited dependent variables [J]. *Econometrica: journal of the Econometric Society*, 1958: 24-36.
- [6] Assaf A G, Josiassen A. Identifying and ranking the determinants of tourism performance: A global investigation [J]. *Journal of Travel Research*, 2012, 51(4): 388-399.
- [7] Gibson H J. Sport tourism: a critical analysis of research [J]. *Sport management review*, 1998, 1(1): 45-76.
- [8] Taks M. Social sustainability of non-mega sport events in a global world [J]. *European Journal for Sport and Society*, 2013, 10(2): 121-141.
- [9] Ding, J. Evaluation and analysis of the development of the sports tourism industry in the Gansu section of the New Silk Road [J]. *Sports World (Academic Edition)*, 2017, (12): 21-33.
- [10] Chen, Y., & Yue, Y. S. Spatial-temporal patterns and influencing factors of efficiency in China's sports tourism scenic areas [J]. *Resources and Environment in Arid Regions*, 2024, 38(3): 152-160.
- [11] Banker R D, CHARNES A, COOPER W W. Some models for estimating technical and scale inefficiencies in data envelopment analysis [J]. *Management science*, 1984, 30(9): 1078-92.
- [12] Tone K. A slacks-based measure of efficiency in data envelopment analysis [J]. *European journal of operational research*, 2001, 130(3): 498-509.
- [13] Ma, X. L., & Bao, J. G. Evaluating the using efficiencies of Chinese national parks with DEA [J]. *Geographical Research*, 2009, 28(3): 838-848.
- [14] Dong, H. M. Tourism efficiency of different types of scenic areas in China [J]. *Resources Development and Market*, 2021, 37(10): 1264-1270.
- [15] Yu, H., Lu, L., & Li, Y. J. Tourism efficiency characteristics, classification, and improvement paths of lake-type national scenic spots [J]. *Scientia Geographica Sinica*, 2015, 35(10).
- [16] Pan, Q. L., Song, Y. Q., Chen, L., et al. Spatial pattern and influencing factors of county-level tourism efficiency in Shaanxi Province [J]. *Journal of Natural Resources*, 2021, 36(4).
- [17] Han, Y. J. Spatial-temporal characteristics and industrial differences of tourism industry efficiency in Chinese cities [J]. *Commercial Research*, 2013, (11): 6-12.
- [18] Cao, F. D., Huang, Z. F., Wu, J., et al. Measurement of tourism efficiency and location accessibility analysis in national scenic areas [J]. *Acta Geographica Sinica*, 2012, 67(12).
- [19] Wang, H., & Hu, S. D. Influencing factors and strategies of tourism industry investment efficiency along the Belt and Road based on the Tobit model [J]. *China Soft Science*, 2017, (12): 9-16.
- [20] Xu, D., Huang, Z. F., Hu, X. H., et al. Spatial evolution and influencing factors of county-level tourism efficiency in Zhejiang Province [J]. *Economic Geography*, 2018, (5): 11-19.
- [21] Liu, M., & Hao, W. Study on influencing factors of spatial distribution of A-level tourist attractions in Shanxi Province [J]. *Acta Geographica Sinica*, 2020, 75(4): 11-21.
- [22] Yue, L., & Lei, Y. Y. Spatio-temporal evolution and influencing factors of green transformation efficiency of tourism resources in China [J]. *Statistics and Decision*, 2021, (22): 5-12.
- [23] Tian, X. H., Lu, F., & Xu, C. R. Measurement and spatial correlation analysis of ecological

efficiency in the middle and lower reaches of the Yellow River based on the super-efficiency SBM model [J]. Journal of Xinyang Normal University: Natural Science Edition, 2023, 36(1): 89–97.

[24] Jin, Y. K., Fang, X. F., & Liu, X. J. *Spatial-temporal evolution characteristics and causes of high-quality sports tourism projects in the Yellow River Basin (F). In Proceedings of the 1st National Symposium on High-Quality Development of Outdoor Adventure and Leisure Sports & the 2nd National Conference on First-Class Undergraduate Program Construction in Leisure Sports, and the 2nd Academic Forum of Leisure Sports in Capital Universities. 2024.*

[25] Chu, C. J., & Gao, X. R. *Spatio-temporal evolution and influencing factors of tourism ecological efficiency in Henan Province [J]. Tourism Research, 2024, 16(4): 40–53.*