ECONOMIC BENEFIT EVALUATION OF FOREST ECO-TOURISM ATTRACTIONS BASED ON FACTOR ANALYSIS

Qiong Sun
Beijing Union University
Beijing, 100101
China

Xiuping Nie*
Beijing Union University
Beijing, 100101
China
niexiupbuu@163.com

Zhiyong Tan
Beijing Open University
Beijing, 100081
China

Wei Su
Henan Polytechnic
Henan, Zhengzhou, 450046
China

Abstract. With the rapid development of economy, the tourism in China has flourished and eco-tourism has emerged. Eco-tourism is an inexorable trend in the sustainable development of tourism. Requirements for eco-tourism attractions are compared to ordinary tourist attractions. This study selected the forest eco-tourist attraction in Yunnan as an example because Yunnan has a warm climate, beautiful sceneries and rich forest resources. The economic benefits of the attraction were analyzed using factor analysis method. Score was calculated through extracting common factor, the index variables were processed, and the index results were then applied to the solution formulas. The obtained economic benefit results were analyzed and compared. Finally, relevant suggestions were proposed for local government, citizens and tourists. This work provides a reference for the economic construction and development of forest eco-tourism attractions in the future.

Keywords: factor analysis, forest eco-tourism, economic benefits, evaluation.

1. Introduction

Since the 21st century, forest area has greatly reduced with the rapid development of economy and the acceleration of urbanization [14]. People demand more about nature and are eager to get close to nature. With the rising of tourism,

*. Corresponding author

people tend to get closer to nature by means of tourism. But some areas have been excessively developed for pursuing economic benefits despite resource and environmental bearing capacity and moreover the uncivilized behaviors of some tourists make tourist environment worse and worse, leading to the increasing demand on eco-tourism [21].

Forest eco-tourism has captured the attention of the whole world rather than China alone. After the Second World War, countries such as America, Germany, England, Japan and France began to put emphasis on forest eco-tourism and spent heavily on building forest eco-tourism attractions. With the development of forest eco-tourism attractions, many benefits have been produced [22]. China, one of the countries with the largest number of eco-system categories, has rich forest resources [26]. Yunnan, in the southwest of China, covers an area of 19.924 million qing (1 qing = 6.6667 hectares) [24] and had a forest coverage rate of 55.7% till 2015; Yunnan has rich forest resources, beautiful sceneries and a pleasant climate.

Till December 2015, Yunnan has had 41 forest ecological parks with a total area of 150, 000 hectares and 159 natural reserve areas which covers an area of 2,840 thousand hectares [7] and a forest tourism system dominated by forest park and natural reserve area has formed preliminarily [9]. Wu B. J. [16] made a tourist satisfaction evaluation and analysis for Guangdong Dawang Mountain National Forest Park using importance-performance analysis diagram, perfected the deficiencies, and proposed strategies of Dawangshan forest eco-tourism development according to quadrant distribution. Zhan H. et al. [19] discussed the eco-tourism resources in natural conservation areas using gray cluster model and formulated an eco-tourism resources evaluation indicator system according to the environmental characteristics and research suggestions. This study made a factor analysis on the national forest parks in Yunnan. Yunnan is one of the minority enclaves and has wonderful national culture. Therefore, the forest eco-tourism attraction in Yunnan is more representative.

Introduction of scenic spot

Pudacuo national forest park, the first national park in China, locates in Shangri-La and covers an area of 1, 313 square kilometers; it is 22 kilometers away from the county [13]. The park has national sceneries such as plateau lakes; hence it is a good place for tourists. By now, the management right and operation right of the park have been separated. Besides, it has four basic functions, i.e., ecological protection, amusement, scientific research and survey and education practice [4].

Xishuangbanna forest park locating in Jinghong city, accounts for 1666.7 square kilometers [18]. It is the only tropical rain forest protection area in China. People are attracted by the park for its amazing animals and precious flowers and plants. The park relies mainly on tropical rain forest sightseeing,

while relaxation and vacation are subsidiary, embellished by national customs [10].

Laojunshan national park locates in the west of Lijiang [8]. It gains its name because the local people say that TaishangLaojun (the supreme god of Taoism) is refining dan on the mountain. The park accounting for 1,324 square kilometers is famous for Danxia landform and picturesque peaks and rocks and it is called the originator of mountains in Yunnan province [23]. Centering on resource protection and tourism development, overall planning and all-round consideration and making progress while maintaining stability are the cores of the development and construction of Laojunshan.

The establishment of evaluation model based on factor analysis

Principle introduction

The indexes were grouped according to the correlation between them. The most representative common factor was selected out from each group [6]; thus we obtained several different common factors and calculated variance. To be short, the weight of evaluation was obtained by analyzing the selected factors.

Model establishment

Suppose that α scenic spots were selected and every scenic spot had β benefit indexes. Let original variable A (the mean value of $A_1, A_2, \ldots, A_\beta$) be equal to 0 and standard deviation equal to 1, then $B = (B_1, B_2, \ldots, B_\beta)$ was obtained. Index variables were supposed as $C_1, C_2, \ldots, C_\beta$ and common factors as $g_1, g_2, \ldots, g_t (t < \beta)$. Suppose that $B = (B_1, B_2, \ldots, B_\beta)$ index vector was observable, then $E(B) = 0$ and covariance matrix $cov(B) = \Sigma$. Besides, $G = (g_1, g_2, \ldots, g_t)$, $(t < \beta)$ variable was unobservable, then $E(G) = 0$ and covariance matrix $cov(G) = M$. Every component was independent from each other.

$\gamma = (\gamma_1, \gamma_2, \ldots, \gamma^\beta)$ and G were independent from each other; $E(\gamma) = 0$; the diagonal matrix of $\Sigma(\gamma)$ was

$$(2-2-1) \qquad cov(\gamma) = \begin{pmatrix} \mu_{11}^2 & & & 0 \\ & \mu_{22}^2 & & \\ & & \cdots & \\ 0 & & & \mu_{\beta\beta}^2 \end{pmatrix}$$

If β original variables were expressed as $g_1, g_2, \ldots, g_t$, then we have:

$$(2-2-1) \qquad \begin{cases} B_1 = w_{11}g_1 + w_{12}g_2 + \ldots + w_{1t}gt + \gamma_1 \\ B_2 = w_{21}g_1 + w_{22}g_2 + \ldots + w_{2t}g_t + \gamma_2 \\ \ldots \\ B_\beta = w_{\beta 1}g_1 + w_{\beta 2}g_2 + \ldots + w_{\beta t}g_t + \gamma_\beta \end{cases}$$

i.e.,

$$= WG + \gamma, W = \begin{pmatrix} w_{11} & w_{12} & \dots & w_{1t} \\ w_{21} & w_{22} & \dots & w_{2t} \\ & & \dots & \\ w_{\beta 1} & w_{\beta 2} & \dots & w_{\beta t} \end{pmatrix}.$$

We called W as factor loading matrix and its elements as factor loading. Then the score of single common factor was calculated. Suppose original data matrix $A = (a_{ij})_{\alpha \times \beta}, (I = 1, 2, \dots, \alpha;\ j = 1, 2, \dots, \beta)$, we have $\widehat{G} = W' R^{-1} A(2 - 2 - 3)$ (W: factor loading matrix; R: original variable related matrix; A: original vector).

The selection of economic benefit indexes

Following the principles of scientificity, integrity and feasibility [1], the selected economic benefit evaluation indexes were summarized.

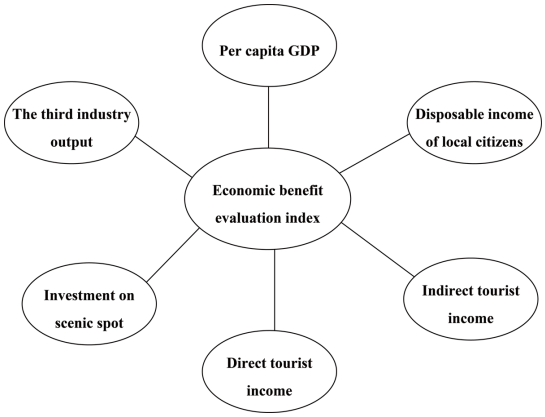

Figure 1: Economic indexes

Per capita GDP

Per capita GDP is an important index for reflecting the economic development condition and living level in an area; it can be obtained by dividing total output value in some period by population [1].

Per capita GDP, permanent resident population and rank / Group	Pudacuo national forest park	Xishuangbanna forest park	Laojunshan national park in Lijiang
Per capita GDP in 2015	39582.31	29031.98	22745.1
Rank	3	4	10
Permanent resident population (ten thousand)	40.7	115.7	127.5

Table 1. Per capita GDP of three scenic spots and their ranks in Yunnan

The comparison of the three parks suggested that, the per capita GDP of Pudacuo national forest park was the highest because it has a small permanent

resident population; the per capita GDP of Xishuangbanna ranked the second among the three scenic spots, but it had the highest total output value; the per capita GDP of Laojunshan ranked low due to the large permanent resident population.

Per capita disposable income of local citizens

Per capita disposable income refers to the income spending on daily life after the deduction of tax, which can fully display the living level of citizens [1]. In 2015, the per capita income of Pudacuonational forest park, Xishuangbanna park and Laojunshan national park was 6,487 yuan, 10, 080 yuan and 6, 037 yuan respectively.

Direct tourist income

Direct tourism income refers to ticket income. Tourists need to pay a certain amount of money before entering scenic spots. The charge is different in every scenic spot, and some scenic spots are even for free.

Indirect tourist income

Indirect tourist income comes from accommodation, catering, entertainment, transportation, collocation and performance watching. The sum of direct tourist income and indirect tourist income is the total income of a scenic spot.

Group / Year	Pudacuo national forest park	Xishuangbanna forest park	Laojunshan national park in Lijiang
2015	3.14	4.13	5.84

Table 2. Total income of the three scenic spots (unit: 0.1 billion yuan)

Investment on scenic spot

The money that government or enterprise put into the construction and perfection of scenic spots is called investment on scenic spots. It can effectively reflect the emphasis of governmental departments and enterprises on scenic spots.

Appreciation of the third industry

Forest eco-tourism not only can increase local tourism income, but also can significantly promote the third industry such as real estate in local area; hence it is taken as one of the economic benefit evaluation indexes [15].

Group / Year	Pudacuo national forest park	Xishuangbanna forest park	Laojunshan national park in Lijiang
2015	5.52	5.84	4.32

Table 3. Appreciation of the third industry in the three scenic spots (unit: 0.1 billion yuan)

Analysis of economic benefit evaluation results

Data in year 2015 were selected. Per capita GDP was supposed as A_1, per capita disposable income as A_2, total income as A_3, the output of the third industry as A_4, and original matrix as A. The detailed data are shown in table 4.

Group / Economic benefit index	Pudacuo national forest park	Xishuangbanna forest park	Laojunshan national park in Lijiang
Per capita GDP	39582.31	29031.98	22745.1
Per capita disposable income (yuan)	6487	10080	6037
Total income (0.1 billion yuan)	3.14	4.13	0.94
Appreciation of the third industry output (0.1 billion yuan)	5.52	5.84	4.32

Table 4. Summary of economic indexes

$$A = \begin{pmatrix} 39582.31 & 6487 & 3.14 & 5.52 \\ 29031.98 & 10080 & 4.13 & 5.84 \\ 22745.1 & 6037 & 5.84 & 4.32 \end{pmatrix}$$

Using SPSS 17.0, relevant coefficients were obtained, as shown below.

	B_1	B_2	B_3	B_4
B_1	1	0.684	0.237	-0.796
B_2	0.684	1	-0.398	-0.951
B_3	0.237	-0.398	1	0.562
B_4	-0.796	-0.951	0.562	1

Table 5. Relevant coefficients of the original index matrix

The observation of relevant coefficients of the original matrix suggested that, per capita GDP and per capita disposable income was in a highly negative correlation, indicating there was a huge gap between per capita GDP and per capita disposable income and there was no correlation between per capita disposable income and the appreciation of the third industry output; per capita GDP was in a positive correlation to per capita disposable income, suggesting the improvement of per capita GDP was beneficial to per capita disposable income; total input was in a positive correlation to the appreciation of the third industry output and they promote each other.

Table 6 demonstrates that, the accumulated variance contribution rate of the first and third factor reached 100%, but the rate of the other factors was so low that it can be ignored. Hence the first and third factors could be taken for effectively evaluating the economic benefit of scenic spots. Through calculating loading factor matrix, we have:

	Characteristic value	Variance contribution rate	Accumulated variance contribution rate	Characteristic value	Variance contribution rate	Accumulated variance contribution rate	Characteristic value	Variance contribution rate	Accumulated variance contribution rate
1	4.845	49.337	49.337	4.845	49.337	49.337	4.839	49.116	49.116
2	1.75E-14	1.95E-15	100						
3	4.729	48.651	48.651	4.729	48.651	100	4.697	4.697	100
4	2.42E-14	2.99E-15	100						

Table 6. Variable characteristic values and variance contribution rates

	1	3
B_1	0.913	0.501
B_2	-0.795	-0.416
B_3	0.436	0.891
B_4	0.893	0.124

Table 7. Factor loading matrix

After substituting the above values into expression $(2-2-2)$, we have:

$$B_1 = 0.913g_1 + 0.501g_3 \tag{1}$$

$$B_2 = 0.795g_1 - 0.416g_3 \tag{2}$$

$$B_3 = -0.436g_1 + 0.891g_3 \tag{3}$$

$$B_4 = -0.893g_1 + 0.124g_3. \tag{4}$$

Referring to the expression, we found the absolute value of factor loading capacity was smaller or equal to 0.5. There was overlapped information, suggesting the correlation still could be reduced. After rotation, we obtained the matrix after transformation.

	1	3
B_1	0.999	0.483
B_2	-0.665	-0.283
B_3	0.998	0.756
B_4	0.463	0.084

Table 8. Factor loading matrix obtained after rotation

After substituting the above data into the expression $(2-2-2)$, we have:

$$B_1 = 0.999g_1 + 0.483g_3 \tag{5}$$

$$B_2 = -0.665g_1 - 0.283g_3 \tag{6}$$

$$B_3 = 0.998g_1 + 0.765g_3 \tag{7}$$

$$B_4 = 0.463g_1 + 0.084g_3 \tag{8}$$

After rotation, we found that, the absolute value of factor loading capacity was smaller or equal to 0.552; hence the rotation method was not available. Thus we explained g_2 and g_4 by taking g_1 and g_3 as common factors.

Coefficient matrix obtained by regression method was as follows.

	1	3
B_1	0.203	0.025
B_2	-0.092	-0.185
B_3	-0.074	-0.114
B_4	0.161	0.098

Table 9. Factor score coefficient matrix

Then the values of g_1 and g_3 of the three parks were calculated and ranked, as shown below.

Group	g_1		g_3			
	Score	Rank	Score	Rank	Total score	Total rank
Pudacuo national forest park	0.8513	1	0.1533	2	1.0046	1
Xishuangbanna national park	-0.394	3	0.1619	1	-0.2321	3
Laojunshan national park	0.395	2	0.1206	3	0.5156	2

Table 10. Ranking of common factor scores of the three scenic spots

g1 of Pudacuo national forest park ranked the first, g_3 of Xishuangbanna national park ranked the first, the total score of Pudacuo national park was 1.0046, suggesting the economic benefit of Pudacuo national forest park was the highest, followed by Laojunshan and Xishuangbanna.

Besides, we found two problems. The first problem is that, insufficient investment can inhibit the development of the forest park. Though the scale of scenic spots is continuously enlarged, the mode of input being larger than output remains unchanged and economic benefit is not as expected [17]. The fund invested on forest park come from the government and enterprises. However, the fund assigned to every scenic spot is low because Yunnan province is a major tourism province and has many scenic spots, resulting in no increase of economic benefit. The second problem is that the management model is affected by problems left over by history. For example, Pudacuopark was not a national park when it was established. At first, it was managed by enterprises, but then thoroughly managed by the government; currently, the management right and operation right of the park are separated [20]. But the defects existing when the park was managed by enterprises still have influence. Diqing state government as the main part has the power of administrative jurisdiction and departments at different levels play a supervision role; the insufficient agent authorization of scenic spot authority blocks the joint development of scenic spots and communities. The working efficiency of scenic spots is low due to the inconsistent attitudes of investment companies and authority to policies. Moreover, there are no definite laws for the construction and management of Pudacuo national forest park locating in minority habitation in China and the enforcement sys-

tem of the park originated from foreign countries, which is inconsistent with the national condition.

Suggestions for the development of forest eco-tourism in Yunnan

Suggestions to government

The leading function of government should be combined with the pushing action of market to improve management efficiency [5]. In the initial construction period of forest national park, the government should play a leading role and emphatically promote the establishment of regulations of scenic spots. Moreover, the market allocates resources. What is more, the assistance of enterprises and the public is indispensable [25]. Only in this way can we promote the establishment of forest parks, improve per capita GDP of scenic spots and drive the harmonious development of the third industry.

Suggestions to scenic spots

The first suggestion is to optimize the existing products and develop new products. The characteristics of forest parks should be put into full play and combine with the advantages of local area. Besides, network should be internationalized to keep up with the trend of age and products need to be refined by considering the demand of tourists [11]. As shown in figure 2, there are totally three categories of tourism products and several subcategories.

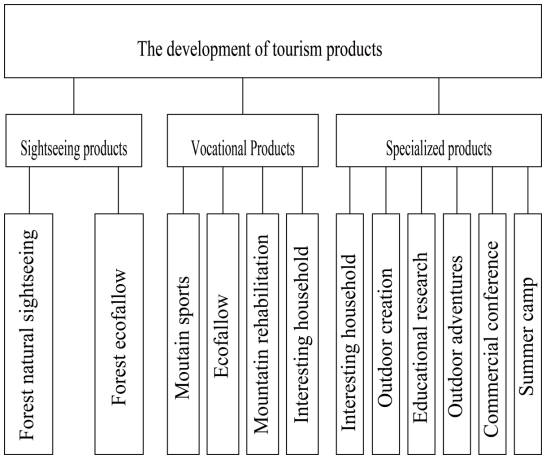

Figure 2: Product development

Secondly, scenic spots should establish good public image and improve popularity [2], i.e., strengthen publicity, cultivate special culture and do cultural transmission.

Lastly, the introduction of talents should be attached great importance. On the one hand, scenic spots should enroll students from relevant professions. On the other hand, scenic spots can cultivate those students to carry out researches to guide practice [3].

Suggestions to local citizens

Local citizens should pay attention to or utilize culture and form a hospitable atmosphere spontaneously to make guests feel at home. Yunnan is a province with the most minorities; besides Han nationality, there were another 25 nationalities living in Yunnan. Every nationality has its own special culture. Local citizens and the other nationalities can learn from each other and seek common points while reserving difference to make local culture yield unusually brilliant results [12].

Conclusion

There are many ways for evaluating the economic benefits of a tourist attraction, and factor analysis method is one of them. Firstly, factors were selected from economic field; then common factor was selected after multiple factors were analyzed and calculated; the demonstration of benefits using common factor provided the evaluation of economic benefit of scenic spots with data support and finally the economic benefits of forest ecological scenic spots were systemically assessed. Based on it, some suggestions were proposed to the establishment of scenic spots, aiming to improve the benefits of scenic spots.

Acknowledgements. This study was supported by the General Project of the Beijng Municipal Education Committee's Scientific and Technological Plan (KM201711417013) to Sun Qiong.

References

[1] V. Bystrov, A.D. Salvatore, *Martingale approximation of eigenvalues for common factor representation*, Statistics & Probability Letters, 83(1) (2013), 233-237.

[2] G. Chen, M. Firth, O. Rui, *Have China's enterprise reforms led to improved efficiency and profitability?*, Emerging Markets Review, 7 (2006), 82-109.

[3] Y. Chen, Y. X. Yang, A.Y. Xu, *Study on the sustainable development of eco-tourism in the Tianhuajing national forest park*, Journal of Jiujiang University, 31 (2007), 129135.

[4] H. Cheng, X.J. Huang, C.O. Pharmacy, *Study on Characteristic and Actuality of Lisaw National Medicine in the Nujiang River Basin of Yunnan Province*, Lishizhen Medicine & MateriaMedica Research, 24 (2013), 2512-2514.

[5] B. Frantál, J. Kunc, *Wind turbines in tourism landscapes: Czech Experience*, Annals of Tourism Research, 38 (2011), 499-519.

[6] L. Galicia, A. Garciaromero, *Land Use and Land Cover Change in Highland Temperate Forests in the Izta-Popo National Park*, Central Mexico. Mountain Research & Development, 27 (2007), 48-57.

[7] M.A. Guoqiang, M. Liu, Y. Zhou, *The Assessment of Recreational Effect on Diversity and Feeding Distance of Birds - A Case Study in Pudacuo National Park*, Forest Resources Management, 314 (2012), 76-82.

[8] Y. Hou, S. Peng, F. Li, Z. G. Lin, M. C. Bao, H. Peng, *Characteristics and scientific values of ecological succession in Danxia Landform of China*, Acta Ecologica Sinica, 28 (2008), 3384-3389.

[9] D.S. Li, S. Fan, A. He, F. Yin, *Forest resources and environment in China*, Chinese Forestry Science & Technology, 9 (2005), 88-95.

[10] B.Y. Liang, H. Peng, S. X. Weng, *Study of the impact of tourism development to the interpersonal relationship in rural society: cases from Danxiashan scenic spot*, Human Geography, 86 (2015), 1-1.

[11] X.T. Lü, J. X. Yin, M. R. Jepsen, J. W. Tang, *Ecosystem carbon storage and partitioning in a tropical seasonal forest in Southwestern China*, Forest Ecology & Management, 260 (2010), 1798-1803.

[12] J. Y. Luo, X. M. Xue, *Survey on Participatory Tourism Development in Luorong Community AroundPudacuo National Park in Shangri-La*, Journal of Southwest Forestry University, 2010, 71-74.

[13] D.G. Pearce, *The internationalization of tourism research*, Journal of Travel Research, 53 (2014), 267-280.

[14] C.Q. Tang, C. R. Chiou, C. T. Lin, J. R. Lin, C. F. Hsieh, J. W. Tang, W. H. Su, X. L. Hou, *Plant diversity patterns in subtropical evergreen broad-leaved forests of Yunnan and Taiwan*, Ecological Research, 28 (2013), 81-92.

[15] D.L. Wang, C. Fang, B. Gao, J. Huang, Q. Yang, *Measurement and Spatio-temporal Distribution of Urbanization Development Quality of Urban Agglomeration in China*, Chinese Geographical Science, 21 (2011), 695-707.

[16] B.J. Wu, *IPA Analysis of Forest Eco-tourism Tourist Satisfaction Evaluation-A Case Study in Dawangshan National Forest Park in Guangdong*, Journal of Fujian Forestry Science & Technology, 2016.

[17] F.Y. Ye, *A quantitative relationship between per capita GDP and scientometric criteria*, Scientometrics, 71 (2007), 407-413.

[18] J.Q. Zhao, Y. S. Zhao, Y. F. Wen, *Development and countermeasures of flower industry in Yunnan*, China, Ecological Economy, 4 (2008), 151-160.

[19] H. Zhan, S. Liu, Q. Shao, *Evaluation of Eco-tourism Resources of Forest Nature Reserves Based On Grey Cluster Model*, 27 (2015), 249-258.

[20] C.S. Zhang, S. Dahan, *Separation of Government Administration from Commune Management Is a Need of Rural Economic Development and of Building Political Power*, Journal of the American Psychiatric Nurses Association, 14 (2009), 429-41.

[21] Z.J. Zhao, L. Y. Tan, D. W. Kang, Q. J. Liu, J.Q. Li, *Responses of Picealikiangensis radial growth to climate change in the Small Zhongdian area of Yunnan Province*, Southwest China. Chinese Journal of Applied Ecology, 23 (2012), 603-9.

[22] Y. Zheng, *Model of Developing the Custom and Cultural Tourism in the Area of Man Nationality*, Journal of Dalian Nationalities University, 189 (2007), 5-16.

[23] Z. Zheng, Z. Feng, M. Cao, Z. Li, J. Zhang, *Forest Structure and Biomass of a Tropical Seasonal Rain Forest in Xishuangbanna*, Southwest China1, Biotropica, 38 (2006), 318-327.

[24] S. Zhong, Z. Wei, *Empirical research on tourism environment and tourists' perception[C]*, IEEE, International Conference on Software Engineering and Service Science, IEEE, 2012, 437-440.

[25] G. Zhang, *Current Situation and Prospects of Research on Landscape Ecological Plans of Forest Scenic Spots*, Scientia Silvae Sinicae, 45 (2009), 144-151.

[26] D.Q. Zhou, R. E. Grumbine, *National parks in China: Experiments with protecting nature and human livelihoods in Yunnan province*, Peoples' Republic of China (PRC), Biological Conservation, 144 (2011), 1314-1321.

Accepted: 7.03.2017