

Evaluation on Tourism Ecological Security in Nature Heritage Sites —Case of Kanas Nature Reserve of Xinjiang, China

LIU Xuling¹, YANG Zhaoping², DI Feng², CHEN Xuegang³

(1. Tourism School, Xinjiang University of Finance & Economics, Urumqi 830012, China; 2. Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences, Urumqi 830011, China; 3. School of Geography Science and Tourism, Xinjiang Normal University, Urumqi 830054, China)

Abstract: The nature heritages are the precious legacy of nature with outstanding scientific and aesthetic value. They are quite different from other common ecotourism areas, because of its original and unique system, sensitive and vulnerable landscape, and peripheral cultural features. Therefore, the tourism development in the nature heritage sites should be on the premise of ecological security. The evaluation index system of tourism ecological security in nature heritage sites was constructed in this article by AHP and Delphi methods, including nature ecological security, landscape visual security and local culture ecological security, and the security thresholds of indices were also established. In the indices' weights of the evaluation model, the nature ecological security ranked the highest, followed by tourist landscape visual security and culture ecological security, which reflected the influence degree of the limited factor to tourism ecological security. Then, this paper carried out an empirical study of Kanas of Xinjiang Uygur Autonomous Region, China, which has the potential to be the World Nature Heritage. On the basis of the data attained from survey and observation on the spot, as well as questionnaire answered by tourists and local communities, the ecological security status in Kanas was evaluated. The result showed that the status of Kanas tourism ecological security was better, but there had some limiting factors. Lastly, effective measures were put forward to ensure its ecological security.

Keywords: nature heritage; tourism; ecological security; nature ecological security; landscape visual security; local culture ecological security; Kanas

1 Introduction

With the rapid tourism development, both the World Nature Heritages and some nature reserves and ecotourist destinations with world heritage value are all becoming the hot tourist spots in the world. Meanwhile, the ecological security in nature heritage sites has caused wide public concerns and tourism activity has become the greatest threat (Ross and Wall, 1999a). The nature heritages are the precious legacy of nature with outstanding scientific and aesthetic value. Due to their original and unique systems, sensitive and vulnerable landscapes and mostly having marginalized traditional culture of ethnic minority, nature heritage sites are quite different from general ecotourist scenic area. It is of great theoretical and practical significance to construct

tourism ecological security evaluation system of nature heritage sites. It not only helps us understand the existing eco-environmental problems scientifically, but also sets up nature heritage resources protection system.

As a new concept put forward in recent years, ecological security still has no generally accepted definition. There is a wide range of researches taken by domestic and foreign scholars, which mainly concentrated on ecological security review and evaluation, and whose scale involved country, region, city, agriculture area, nature reserves and so on.

Although there are few literatures on ecological security of tourism and nature reserve, the idea of ecological security has been integrated with the previous ecotourism and sustainable tourism researches (Simon et al., 2004; Yu, 1999; Sun and Wang, 2000; Liu et al., 2005).

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Corresponding author: YANG Zhaoping. E-mail: yangzp@ms.xjb.ac.cn

Dong Xuewang (2003) introduced the theory of ecological security to sustainable tourism development and proposed the concept of ecological security for the representation of tourism sustainable development, in which natural resources and ecological environment were in a healthy state, balanced trend and also faced no threat. Under this balanced situation, the ecosystem could be sustained and met the needs of tourist sustainable development. Cao Xinxiang et al. (2006) considered that tourism ecological security referred to the tourism development that would not cause irreversible changes to ecological system and not lead to its degradation, even collapse.

For the tourism system, a special geographical system, tourism ecological security is related to not only biological factors but tourist activities, such as natural and human landscape, community culture, etc.

In my opinion, tourism ecological security is that the resources tourism depends on are in a sustainable healthy and balanced state, including natural resources, ecological environment, tourism landscape aesthetic quality and traditional folk culture. In other words, in certain tourism region and period, the natural ecological system maintains a normal healthy structure and function, the aesthetic quality of natural and tourism architectural landscapes is not damaged, and the local communities' folk culture keeps its traditional characteristics. If the above main aspects can meet the needs of tourism and local socio-economic sustainable and healthy development, it is known as ecological security; if on the contrary, it is known as insecurity.

Ecological security evaluation is mainly an evaluation on the ecosystem's elements, structure and function. Different geographical system has its own evaluation index system. Now, there are some international ecological security index systems, such as "Human Activity Index (HAI)", "Human Development Index (HDI)", and "Pressure-Status-Response (PSR)" for the global evaluation (Lee and Snepenger, 1992; Ross and Wall, 1999b; Yu, 1996). Due to proposing the contrasting pattern between evaluation indices and their standards, PSR model, established by the United Nations Organization of Economic Cooperation Development (OECD), is respected by many scholars. It has been also used in the ecological security evaluation of scenic spot, wetland nature reserve and tourism city (Dong, 2004; Zhang, 1999; Cao, 2006). The Ecological Footprint model was

applied in measurable ecological security evaluation of tourism sustainable development, too (Cao, 2006; Zhou et al., 2008). Other tourist sustainable development evaluation systems were also constructed in China such as eco-evaluation and sustainable development index system in nature reserve, evaluation index system in national ecotourism demonstration zone, etc. (Zheng et al., 1994; Wang, 2001; Cheng et al., 2004).

In the previous evaluation models of tourism ecological security, although they are different in research perspective and evaluation index and each has its own advantages and disadvantages, the aspects of ecological environmental quality and impact and the coordination between ecology and tourism development are all regarded as important indices and standards, which are also of great significance to tourism ecological security research. Despite there is no uniform definition and authoritative measuring method of ecological security in the current academic community, ecological security is a sustainable development guideline for regional resources development (Costanza et al., 1997).

2 Evaluation Index System of Tourism Ecological Security

2.1 Connotation of tourism ecological security in nature heritage site

Nature heritage site refers to a peculiar nature zone which has significant or unique natural heritage features and great potential to be the World Nature Heritage, including nature reserve, national park and those virgin nature landscapes, etc. So nature heritages include both the World Nature Heritage and other nature heritages with outstanding scientific and aesthetic value, which are gems favored by nature and wealth belonging to the human.

Natural Heritage is a complex resources synthesis and also a special eco-tourist destination. Compared with the common ecotourism spots in China, the special characteristics in nature heritage sites include remote tourist location, peculiar and unique tourist resources, sensitive and vulnerable landscape, and peripheral features in local culture. The tourism ecological security in nature heritage site aims to protect the heritage's authenticity and integrality, namely ensuring the aboriginality of natural ecosystem, the integrality of landscape aesthetics and the authenticity of traditional culture. However, the

existing problems of tourism ecological security in nature heritage sites are mainly resources destruction, environmental degradation, landscape contamination, urbanization of scenic area and the bad impact on traditional culture, etc. (Gong, 2006).

To sum up, the tourism ecological security in nature heritage site refers to an integrated security system including nature ecological security, landscape visual security and local culture ecological security. Its specific meaning is: 1) Nature ecological security: security of air, water, soil, biological and other elements as well as the health and safety of natural ecological system's structure and function. 2) Tourist landscape visual security: the natural landscape aesthetics security under tourism interference as well as the landscape coordination between man-made constructions and natural landscape. 3) Culture ecological security: the maintenance of local communities' traditional folk culture features and its tourist attraction. Tourist impact on regional traditional culture can not be ignored, including traditional costumes, architecture, language, ideas and so on (Lu et al., 2006).

2.2 Evaluation index system and method of tourism ecological security

Based on the tourist development characteristics and the main problems of tourism ecological security in nature heritage sites, combining Analytical Hierarchy Process with Delphi, the evaluation index system of tourism ecological security in nature heritage sites is constructed, including nature ecological security, landscape visual security and local culture ecological security.

The common 28 indices involved in tourism ecological security at home and abroad are given, and 25 of them were selected by the first round of expert consultation on the importance of indices. The consulted experts major in ecology, geography, tourism, economy and environment. Then, a second round of expert consultation was done, and according to experts' comparison and judgment on the relative importance of each index, the matrix of indices' relative importance was made out. By the principle of AHP and calculated by square root method, the index weights were given. The results are shown in Table 1.

Table 1 Weights of tourism ecological security indices in nature heritage sites

Target layer	Criterion layer	Index weight	State layer	Index weight	Variable layer	Index weight
Tourism ecological security in nature heritage sites	A ₁ Nature ecological security	0.5499	B ₁ Environmental quality	0.2583	C ₁ Air quality	0.5
					C ₂ Water quality	0.5
					C ₃ Treatment of solid waste (%)	0.1712
			B ₂ Environmental sanitation	0.1047	C ₄ Cleanliness of ground (%)	0.1130
					C ₅ Sewage treating rate (%)	0.1857
					C ₆ Utilization rate of clean energy (%)	0.1712
					C ₇ Tourist environment satisfaction rate (%)	0.3589
			B ₃ Biodiversity	0.6370	C ₈ Species composition	0.493
					C ₉ Aboveground biomass on grassland (kg/m ²)	0.305
					C ₁₀ Vegetation coverage rate (%)	0.202
	A ₂ Landscape visual security	0.2402	B ₄ Tourism construction	0.2745	C ₁₁ Dissimilated tourism architecture rate (%)	0.2583
					C ₁₂ Tourism construction density (%)	0.1047
					C ₁₃ Suitability of location (%)	0.6370
			B ₅ Road construction	0.1228	C ₁₄ Naturalness of road line (%)	0.75
					C ₁₅ Localization rate of material selection for trail (%)	0.25
			B ₆ Pipeline facility	0.0624	C ₁₆ Buried rate of pipelines (%)	1
					B ₇ Tourist density	0.5403
	C ₁₈ Tourist density in tourist site (m ² /(person·h))	0.75				
	A ₃ Culture ecological security	0.2098	B ₈ Population security	0.2	C ₁₉ Natural population growth rate (‰)	1
					B ₉ Folk culture security	0.6
			C ₂₁ Identifying rate of traditional costume (%)	0.1563		
			C ₂₂ Resident perception rate of traditional culture change (%)	0.3405		
			B ₁₀ Social benefit of tourism	0.2	C ₂₃ Tourist perception rate of folk culture atmosphere (%)	0.4238
					C ₂₄ Satisfaction degree of improvement of living level by tourism (%)	0.8333
					C ₂₅ Per capita annual tourism income rate (%)	0.1667

2.3 Security threshold of index

The threshold of tourism ecological security indices is shown in Table 2. It follows three standard sources. 1) National standards of P. R. China. ① *Ambient Air Quality Standard* (GB 3095-1996) (State Environmental Protection Administration of P. R. China (SEPA), 1996a); ② *Environmental Quality Standard for Surface Water* (GB 3838-2002) (SEPA, 2002); ③ *Integrated Wastewater Discharge Standard* (GB 8978-1996) (SEPA, 1996b); ④ *Evaluation Index System of Environmental Impact of Resources Development in Mountain Scenic Area* (HJ/T6-94) (SEPA, 1994); ⑤ *Construction Index of Ecological County, Municipality and Province (Trial Implementation)* (SEPA, 2003). 2) Expert experience. Since the development of eco-tourism in China has been less than 10 years, which is a relatively short history, the criteria of tourism ecological security are to be perfect. For the non-standard indices, the thresholds are given by

Table 2 Threshold of tourism Ecological security indices in nature heritage site

Criterion layer	State layer	Variable layer	Index threshold	Source of index threshold
A ₁	B ₁	C ₁ (-)	First standard	GB 3095-1996
		C ₂ (-)	Grade I	GB 3838
	B ₂	C ₃ (+)	100%	Expert experience
		C ₄ (+)	100%	Expert experience
		C ₅ (+)	90%	GB 8978-1996
		C ₆ (+)	90%	Defined by authors
		C ₇ (+)	85%	Expert experience
	B ₃	C ₈ (+)	10	Background value
		C ₉ (+)	0.4kg/m ²	Background value
		C ₁₀ (+)	85%	HJ/T6-94
B ₄	C ₁₁ (-)	25%	Expert experience	
	C ₁₂ (-)	2%	HJ/T6-94	
	C ₁₃ (+)	80%	Defined by authors	
A ₂	B ₅	C ₁₄ (+)	80%	Defined by authors
		C ₁₅ (+)	80%	Defined by authors
	B ₆	C ₁₆ (+)	100%	Defined by authors
	B ₇	C ₁₇ (+)	100m ² /(person-d)	HJ/T6-94
C ₁₈ (+)		5m ² /(person-h)	HJ/T6-94	
A ₃	B ₈	C ₁₉ (+)	2%	National standard*
		C ₂₀ (-)	20%	Defined by authors
		C ₂₁ (+)	80%	Defined by authors
	B ₉	C ₂₂ (-)	20%	Defined by authors
		C ₂₃ (+)	80%	Defined by authors
	B ₁₀	C ₂₄ (+)	80%	Defined by authors
		C ₂₅ (+)	80%	Defined by authors

Notes: Sign +/- shows the positive or negative effect of the evaluating index on tourism ecological security; * means the national standard of *Construction Index of Ecological County, Municipality and Province (Trial Implementation)*, SEPA, 2003;

experts' experience. 3) Background value measured in the study area in 1985. 4) Defined by authors. Some thresholds of evaluation indices are hard to be quantified, especially for those in landscape visual security, which have no uniformed standards so far. There are 11 indices defined by authors such as utilization rate of clean energy, suitability of facility location, etc., which are referred to some related national standards, including *Division and Evaluation on the Quality of Tourism Scenic Areas* (GB/T 17775-2003) (National Tourism Administration of P. R. China, 2003), *Standard for Forest Parks Design* (LY/T5132-95) (Ministry of Forestry of P. R. China, 1995) and *Acceptance Criteria of National Ecological Demonstration Zones* (SEPA, 1998), etc.

2.4 Exponent of tourism ecological security index

The methods of calculating exponent of tourism ecological security index are as following:

Let $X_i (i=1, 2, 3, \dots, n) (n=25)$ be the value of tourism ecological security index C_i , $P(C_i)$ is the exponent of C_i , $0 \leq P(C_i) \leq 1$, XS_i is the threshold of C_i .

For those indices that have positive correlations to ecological security:

$$\textcircled{1} P(C_i) = \begin{cases} 1 & (0 < XS_i \leq X_i) \\ X_i / XS_i & (0 < X_i < XS_i) \end{cases} \quad (1)$$

$$\textcircled{2} P(C_i) = \begin{cases} XS_i / X_i & (X_i < 0, XS_i < 0, \text{ and } |X_i| > |XS_i|) \\ 1 & (X_i < 0, XS_i < 0, \text{ and } |X_i| \leq |XS_i|) \end{cases} \quad (2)$$

$$\textcircled{3} P(C_i) = \begin{cases} 1 & (XS_i < 0 < X_i) \\ 0 & (X_i < 0 < XS_i) \end{cases} \quad (3)$$

For those indices that have negative correlations to ecological security:

$$\textcircled{1} P(C_i) = \begin{cases} 1 & (0 < X_i \leq XS_i) \\ XS_i / X_i & (0 < XS_i < X_i) \end{cases} \quad (4)$$

$$\textcircled{2} P(C_i) = \begin{cases} XS_i / X_i & (X_i < 0, XS_i < 0, \text{ and } |X_i| > |XS_i|) \\ 1 & (X_i < 0, XS_i < 0, \text{ and } |X_i| \geq |XS_i|) \end{cases} \quad (5)$$

$$\textcircled{3} P(C_i) = \begin{cases} 0 & (XS_i < 0 < X_i) \\ 1 & (X_i < 0 < XS_i) \end{cases} \quad (6)$$

2.5 Calculation and classification of tourism ecological security degree

The comprehensive evaluation value of tourism ecological security is calculated by the linear weighing method and the compared calculating method:

$$P(o) = \sum_{i=1}^n W(C_i) \times P(C_i) \quad (7)$$

where $P(o)$ is the tourism ecological security degree, $W(C_i)$ is weight of C_i , $P(C_i)$ is the exponent of tourism ecological security index C_i , n is the index number ($n=25$).

Tourism ecological security degree is classified into four levels (Table 3).

Table 3 Classification of tourism ecological security degree

Level	Quite safe	Relatively safe	Relatively unsafe	Quite unsafe
Ecological security degree $P(o)$	$0.75 \leq P(o) \leq 1$	$0.5 \leq P(o) < 0.75$	$0.25 \leq P(o) < 0.5$	$0 \leq P(o) < 0.25$

3 Case Study

3.1 Situation of Kanas National Nature Reserve

Kanas is located in Burqin County of Altay Prefecture,

Xinjiang Uygur Autonomous Region, China, which is bordered on Russia, Mongolia and Kazakhstan (Fig. 1). Kanas National Natural Reserve, constructed in 1986, is the only four-country-boundary nature reserve in China, and covers an area of 2200km². It is the only place in the tributary of the Ertix River which is the river system from the Arctic Ocean, and the typical distribution region of the Siberian Taiga Forest and the Palaeartic Euro-Siberian wildlife in China. It is also the south extreme extension position of the Siberian Taiga Forests and the only habitation for the Tuva tribe in China. Kanas is a fairyland endowed with rich predominant nature landscape, including alp lakes, snow mountain, modern glaciers, virgin forest and alpine meadow, meandering river, etc. The Kanas region is of great value in economy, eco-environment, scientific research and sightseeing, which has great potential to be the World Nature Heritage.

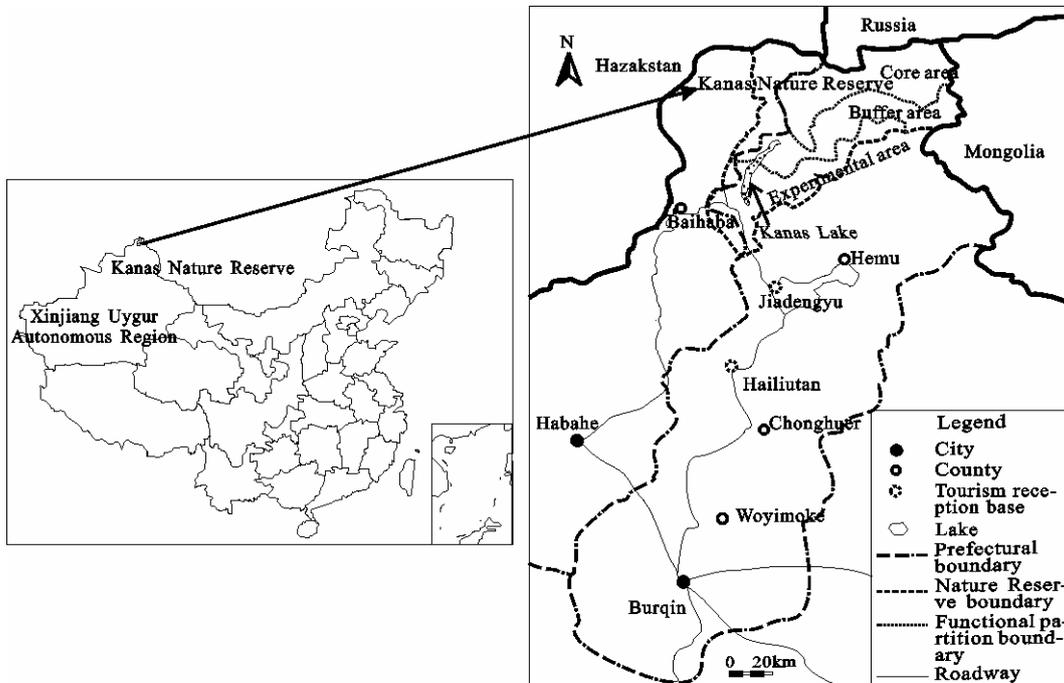


Fig. 1 Sketch map of location of Kanas Nature Reserve

Since 1997, when the roadway from Kanas to Jiadengyu was constructed by Chinese government, the formal tourism development began in Kanas (Yang and Zhang, 2000). The tourists in this region increased sharply from 35,000 in 1997 to 1,314,000 in 2007. Presently, the scenic zone of Kanas Lake is the main tourism developing area, which is in the southern margin of scientific experiments zone of the Kanas Nature Reserve and is a belt with 40km

long from the central of Kanas Lake to reception base of Jiadengyu.

3.2 Data acquisition

(1) The data from field survey and observation. The field monitoring, sampling and analysis were taken to evaluate tourism impacts on ecology and environment in the important spots and the bottleneck spots in July, 2007. The

grassland species composition and ground biomass (fresh weight) were gotten by ten samples with 2m×2m near tour roads and viewing platforms in key areas that tourist activities concentrated, including the Kanas Village, Huanhu Hotel, Jiadengyu, etc. The data of sanitation status and tourist density were from in situ observations while those of the landscape visual impact were given by the expert group after field investigation combined with the national relevant criteria of *Evaluation Index System of Environmental Impact of Resources Development in Mountain Scenic Area* (HJ/T6-94) (SEPA, 1994).

(2) The data from questionnaire investigation and

deep interview. The random sample survey on tourists and local residents in Kanas was conducted from July 1 to 7 in 2006, and 232 and 48 valid questionnaires were recovered respectively. The in-depth interview was also conducted on representative residents which provided relevant data of the tourist impact on community's traditional culture and economy.

3.3 Results and analysis

3.3.1 Exponent of tourism ecological security index

By calculating, the exponents of tourism ecological security index in Kanas are shown in Table 4.

Table 4 Exponent of tourism ecological security index in Kanas

Security index	Index value	Index threshold	Exponent ($P(C_i)$)	Security index	Index value	Index threshold	Exponent ($P(C_i)$)
C_1	First standard	First standard	1	C_{14}	93%	80%	1
C_2	Grade I	Grade I	1	C_{15}	100%	80%	1
C_3	100%	100%	1	C_{16}	20%	100%	0.2
C_4	90%	100%	0.9	C_{17}	800	100	1
C_5	70%	90%	0.778	C_{18}	7	5	0.68
C_6	100%	90%	1	C_{19}	<0	2%	0
C_7	73.8%	85%	0.923	C_{20}	0	20%	1
C_8	6.3 kinds	10 kinds	0.63	C_{21}	12.5%	80%	0.156
C_9	0.27kg/m ²	0.4kg/m ²	0.675	C_{22}	66%	20%	0.303
C_{10}	70%	85%	0.824	C_{23}	39.34%	80%	0.492
C_{11}	31.6%	25%	0.791	C_{24}	79.2%	80%	0.99
C_{12}	1.84%	2%	1	C_{25}	90%	80%	1
C_{13}	76.5%	80%	0.956				

Notes: Bold figures show low tourism ecological security. Due to the imprecise data, the index value of natural population growth rate is less than 0 under the circumstances of not affecting the evaluation results.

Among 25 evaluating indices of Kanas tourism ecological security, there are 10 indices (exponent of tourism ecological security index equals 1) up to and four indices (exponent of tourism ecological security index ≥ 0.9) close to the standard, which are mainly connected with environmental and sanitation quality and landscape visual ecological security. It shows that the ecological security in these aspects in Kanas is better. There are five ones far below standard value (exponent of tourism ecological security index is less than 0.5, even equals 0), which shows that the culture ecological security in Kanas is also pessimistic.

3.3.2 Tourism ecological security degree

By the linear weighing method, tourism ecological security is evaluated and the result is shown in Table 5.

The status of Kanas tourism ecological security is better, and the synthetic evaluation is about 0.7198.

3.3.3 Analysis of limiting factors in tourism ecological security

The exponent of tourism ecological security index only reflects the difference between actual and standard value. The index with low exponent is not certain to have large restriction to tourism ecological security. The weight should also be considered in determining the limiting degree of the various factors on tourism ecological security. The limiting degree of limiting factor can be got by Equation (8) (Dong, 2004):

$$L_i = W_i \times (1 - P(C_i)) \quad (8)$$

where L_i is the limiting degree of limiting factor C_i , W_i is the weight of limiting factor C_i , and $P(C_i)$ is exponent of tourism ecological security index C_i .

Except for 10 indices up to par among 25 evaluating indices of Kanas tourism ecological security, the rest 15

Table 5 Evaluation result of Kanas tourism ecological security degree

Target layer	Criterion layer	Security degree $(P(o))$	State layer	Security degree $(P(o))$	Variable layer	Security degree $(P(o))$		
Tourism ecological security in nature heritage sites	A_1	0.4342	B_1	0.2583	C_1	0.5		
					C_2	0.5		
					B_2	0.0963	C_3	0.1712
							C_4	0.1017
							C_5	0.1445
			C_6	0.1712				
			C_7	0.3313				
			B_3	0.435	C_8	0.3106		
					C_9	0.2059		
					C_{10}	0.1664		
	A_2	0.1917			B_4	0.2520	C_{11}	0.2043
							C_{12}	0.1047
			C_{13}	0.6090				
			B_5	0.1228			C_{14}	0.75
							C_{15}	0.25
	B_6	0.0125	C_{16}	0.2				
			B_7	0.4106	C_{17}	0.25		
					C_{18}	0.51		
			A_3	0.0939	B_8	0	C_{19}	0
	B_9	0.2493					C_{20}	0.0794
					C_{21}	0.0244		
					C_{22}	0.1032		
	B_{10}	0.1983			C_{23}	0.2085		
			C_{24}	0.8250				
			C_{25}	0.1667				
Total value			0.7198					

indices as limiting factors are ranked (Fig. 2). The first six factors are: natural population growth rate (C_{19}), buried rate of pipelines (C_{16}), tourist density in tourist site (C_{18}), resident perception rate of traditional culture change (C_{22}), tourist perception rate of folk culture atmosphere (C_{23}) and species composition (C_8), whose actual value is far below the standard value and should be paid great attention to.

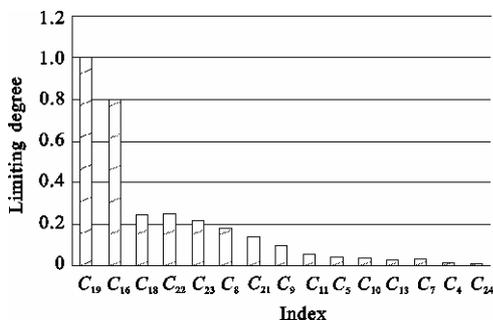


Fig. 2 Limiting degree of tourism ecological security factors in Kanas

Comparison and classification are taken between the limiting degree and weight of limiting factor (Table 6), and it shows the impact of various types of limiting factor on tourism ecological security in Kanas, which is of great significance to tourism ecological security protection and construction of natural heritage sites.

Table 6 Type and characteristics of different limiting factors of tourism ecological security in Kanas

Type	Characteristics	Index
Smaller weight, smaller limiting degree	Smaller limit, better security condition	$C_4, C_5, C_7, C_9, C_{10}, C_{11}, C_{21}$
Bigger weight, smaller limiting degree	Better security condition	C_8, C_{13}, C_{24}
Smaller weight, bigger limiting degree	Poorer security condition	C_{22}, C_{23}
Bigger weight, bigger limiting degree	Bigger limit, poorer security condition	C_{16}, C_{18}, C_{19}

Among 15 limiting factors of tourism ecological security in Kanas, seven factors with smaller W_i and L_i , such as cleanliness of ground (C_4) and sewage treating rate (C_5), etc., reflecting better status in environmental sanitation and biology diversity in Kanas and just a little attention should be paid to. The three factors with bigger W_i and smaller L_i including species composition (C_8), suitability of location (C_{13}) and satisfaction degree of improvement of living level by tourism (C_{24}) are in better security conditions. Attention should be paid to maintaining its existing ecological functions and preventing its deterioration. For the two factors with smaller W_i and bigger L_i including resident perception rate of traditional culture change and tourist perception rate of folk culture atmosphere, etc., special attention should be paid to and more concerns and protections should be given. For those indices with bigger W_i and L_i , the top priority should be given and their small changes will cause tremendous changes to the whole ecological security. Meanwhile, due to their current low level and important role, renovation and construction of them will play a multiplier effect. For Kanas, efficient measures should be taken to distribute tourists, bury pipelines, control the decrease of Tuva population and develop its folk culture deeply.

4 Conclusions

Combining Analytical Hierarchy Process with Delphi, the evaluation index system of tourism ecological security in nature heritage sites is constructed, including nature ecological security, landscape visual security and local culture ecological security. Taking Kanas as an example, tourism ecological security in nature heritage sites was analyzed. In the tourism ecological security evaluation index system, the nature ecological security ranks the highest, followed by tourism landscape visual security and culture ecological security. It indicates that the nature ecological security is the precondition and basis of nature heritage tourism sustainable development. As the necessary tourism facilities, their landscape visual ecological security has great impacts on nature landscape integrality and aesthetics value. Therefore, great attention should be paid to the landscape visual ecological security first. The traditional culture in nature heritage sites is not only the product of historical evolution and development, but important and non-renewable

tourism resources. So the culture ecological security also becomes an important indicator of tourism ecological security in nature heritage sites. The indices' weights reflect the significance of these factors to tourism ecological security, which has a guidance function for the nature heritage sites' tourism development.

The overall status of Kanas tourism ecological security is better, and can be described as relatively safe status. However, there are still some limiting factors. Among 25 evaluating indices, except the 10 ones up to par including air, water and other environmental quality indicators, the remaining 15 ones are limiting factors. Among these factors, some are difficult to change, such as forest coverage rate, the natural population growth rate and so on. But 15 factors can be improved by man-made control and construction. In nature ecological security, it is crucial to reduce the tourist density in some tourism spots. It is not so optimistic in culture ecological security condition and efficient protective and developing measures should be taken to ensure its ecological security. Finally, the overall condition of landscape visual ecological security is good. With more reception facilities moved out to Jiadengyu, landscape visual ecological security can be completely ensured.

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