

Investigation and Evaluation of Rehabilitation Factors in Shipiao Hot Spring Health and Wellness Resort in Yunnan Province, China

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Abstract: Taking the Shipiao Hot Spring Resort in Yunnan Province as the research object, a comprehensive investigation on the rehabilitation factors of the Hot Spring Health and Wellness Resort is carried out through on-the-spot investigation and analysis and questionnaire survey. Subsequently, using GST grey statistical theory and Analytic hierarchy process (AHP), four rehabilitation landscape elements of natural environment, sensory experience, spatial perception and environmental facilities are selected as the main evaluation indexes of hot spring rehabilitation landscape, and the evaluation system of hot spring rehabilitation landscape is constructed. Then, the Yaahp AHP software is applied to process and analyze the survey data, and the current situation of Shipiao Hot Spring rehabilitation landscape is comprehensively evaluated. Finally, the optimization strategy of hot spring environment is put forward according to the scores of four rehabilitation factors.

Keywords: *Hot Spring Health and Wellness Resort; Investigation of Rehabilitation Factors; Evaluation of Rehabilitation; Shipiao Hot Spring; China*

Hot spring health and wellness resort is a health and wellness tourism holiday destination based on hot spring resources, and it is an important type of rehabilitation landscape, which contains excellent hot spring water resources, natural environment, rehabilitation facilities, spa products, health and wellness courses, etc. Rehabilitation factors are environmental factors that play a core role in people's physical and psychological recovery in the rehabilitation environment, including climate, topography, water system, plant levels and diversity in the rehabilitation environment, privacy, scale and function in the process of spatial perception, smell, touch, sound in the environment, etc., and the richness, culture and humanization of environmental service facilities.

As a kind of important resources, hot spring rehabilitation landscape has good physiological health care and psychological regulation to the human body. The hot spring health and wellness resort is attracting more and more people because it is based on colorful landscapes and comfortable and pleasant hot spring environment, supported by scientific health and wellness concepts, guided by different health and wellness needs, and backed by comprehensive health and wellness products. Exactly, the investigation and evaluation of hot spring health and wellness resources is the basis of hot spring environmental resources management and sustainable development. In other words, the investigation and evaluation based on adequate hot spring environmental health and wellness resources provide good conditions for the scientific layout, planning and construction of hot spring health and wellness resort.

In this study, the Shipiao Hot Spring Health and Wellness Resort in Yunnan Province is selected as the investigation and evaluation

object to study the rationality of the elements of the health and wellness hot spring landscape environment, which has important practical significance for exploring the construction of the hot spring health and wellness environment and the optimization of rehabilitation factors.

1. Selection of rehabilitation factors

In the study, we use the rehabilitation elements with high recognition at home and abroad for reference to evaluate the rehabilitation landscape environment, and determine the selection of rehabilitation factors for hot springs. Then, we judge the achievement degree of the core rehabilitation elements of the hot spring, which provides a basis for the future environmental management and rehabilitation environment optimization. In the selection of rehabilitation factors, drawing lessons from the supportive rehabilitation environment design theory put forward by Roger Ulrich, an American scholar, combined with the AHP proposed by American Professor Satie, Chinese Li Shuhua and Liu Boxin, the frequently used indicators are screened out, forming a set of primary indicators based on ecological environment, spatial perception, sensory experience and infrastructure (including 21 indicators). According to the grey statistical analysis method, the primary selection index set of health and wellness hot spring landscape is classified according to "high, medium and low", forming a three-level gray whitening segmentation function ^[1]. In addition, the grey statistical questionnaire is designed using the Likert scale, and the relevant experts in the field of health and wellness landscape and hot spring landscape are asked for their opinions on the importance of pre-selected evaluation indicators. A total of 20 expert questionnaires are sent out and 20 valid questionnaires are

collected. Among the 21 pre-selected indicators, the grey statistical importance of 16 pre-selected indicators is high. According to the grey statistical method, 16 evaluation indexes with "high" importance are selected as the constituent elements of the landscape environment of rehabilitation hot springs (see Table 1).

Table 1 Grey statistical analysis results of rehabilitation factors of rehabilitation hot spring landscape

Rehabilitation factors	Pre-selection indicators	Decision vector	Importance	Whether to choose	Rehabilitation factors	Pre-selection indicators	Decision vector	Importance	Whether to choose			
Climate comfort	15.14	4.88	0	High	Yes	Visual landscape	15.44	4.56	0	High	Yes	
Water environment	10.39	9.17	0.48	High	Yes	Sensor landscape	11.97	6.66	1.8	High	Yes	
air quality	11.77	7.31	0.90	High	Yes	Acoustic landscape	11.97	8.00	6	High	Yes	
Forest quality	11.98	8.08	0	High	Yes	Olfactory landscape	11.48	10.62	0	Medium	No	
Topography	11.66	6.17	2.19	Medium	No	Tactile landscape	12.00	7.11	1	Yes	High	Yes
environment	11.66	6.17	2.19	Medium	No	Infrast landscape	2.67	4.87	0.4	High	Yes	
Community diversity	1.39	8.24	10.37	Low	No	Service facilities	12.46		0	Low		
Environmental cleanliness	1.57	10.33	8.10	Medium	No	Leisure facilities	13.27		6		9.3	
Venue functionality	12.08	8.00	0	High	Yes	Health and wellness facilities	15.13		4			
Spa Site privacy	11.38	8.16	0.50	High	Yes	Local cultural expression	1.7.2		3			
per Venue	10.28	8.40	1.36	High	Yes	Richness of surrounding attractions						

cep accessibility
tion y

Site scale 11.27.34 1.43 High Yes
3

Among the ecological environment elements, topography is the inherent landscape resource of the hot spring area, but it is not selected because it is difficult to develop, utilize and define; despite the community species diversity can reflect the ecological environment of the area, it is not selected, because too many community species will affect the landscape quality, and is not conducive to the development of health and wellness activities; environmental cleanliness belongs to the category of service facilities, so it is not listed separately. Among the elements of sensory experience, taste landscape is not selected because the correlation between taste and the quality of health and wellness hot spring landscape is not high. Among the infrastructure elements, the richness of the surrounding scenic spots is not selected because the purpose of the hot spring health and wellness activities is strong, and it has no real effect on the health and wellness activities.

2. Case investigation

Shipiao Hot Spring Health and Wellness Resort is located in Baoshan, Yunnan Province, China, with a total area of 31468.61 square meters. There are more than 10 natural outfalls in the area. The hot spring water quality is excellent, with the temperature of 50~80°C, and the daily flow of about 1894.3 cubic meters. The main hot spring water outlet has a boulder shaped like a scoop, so it is called Shipiao(Chinese pinyin of stone scoop). With people's understanding of the curative effect of Shipiao Hot Spring, more and more people gather spontaneously in the mountains and forests around the hot spring for recuperation. At its peak, there are as

many as 1,000 persons, forming a "sacred place for folk recuperation."

2.1. Investigation method

The investigation methods of this study are on-the-spot survey and questionnaire survey. The on-the-spot survey method investigates the data and characteristics of all kinds of resources in Shipiao Hot Spring area, and analyzes the advantages and disadvantages of Shipiao Hot Spring health and wellness resources. Investigate the environmental factors of hot spring area, such as water resources, climate environment, altitude, forest resources, landscape environment, hot spring products and so on. Questionnaire is used to investigate the use of Shipiao Hot Spring health and wellness environment and the satisfaction of health and wellness patients. The healers in Shipiao Hot Springs judge the current situation of Shipiao Hot Spring environment by judging the health and wellness resources, effect and comprehensive satisfaction of Shipiao Hot Springs, so as to find out the existing problems and deficiencies and put forward environmental optimization measures. In this study, 200 questionnaires are distributed in the field, 191 valid questionnaires are collected, with the questionnaire recovery rate of 95.50%.

2.2. Survey content

2.2.1 Ecological environment

1) Hot spring water resources. Shipiao Hot Spring Resort is rich in water resources, with a total of 15 water outlets, all of which are natural outlets, with an average effluent temperature of 50-80 °C and a daily flow of 1894.3 cubic meters. According to the water quality inspection report, Shipiao Hot Spring contains a large number of

beneficial to the human body of a variety of minerals and trace elements, the main components are potassium, sodium, calcium, magnesium, carbonic acid, metasilicic acid, the spring quality reaches the high-quality rare hot spring standard, is a rare drinking calcium magnesium hot spring. Bubble bath Shipiao Hot Spring water has a certain rehabilitation effect on rheumatism, skin diseases, trauma, burns, arteriosclerosis and other diseases. In addition, drinking Shipiao Hot Spring water in a planned way can improve diabetes, coronary heart disease, gout, and digestive diseases^[3].

2) Climate resources. The investigation area is a subtropical climate, with dense forests, high mountains and deep valleys, and the hot spring area is located in the valley area on the hillside, with an annual average temperature of 21.10C, an annual precipitation of 1120.00mm, an average annual relative humidity of 76%, an average annual sunshine of 2335.5h, a temperature and humidity index of 68.22 and a comfort rating of grade 0. it is the most comfortable for the human body and is of great help to reduce the heat load on the human body, and can be called an ideal place for summer shelter and warmth.

3) Altitude resources. The altitude that is most beneficial to human health is 1200m to 1500m. At this altitude, it has the most suitable air pressure, the densest negative oxygen ions and the most comfortable temperature. The altitude of Shipiao Hot Spring area is about 1145-1228m. The density and quality of negative oxygen ions in hot spring area are excellent.

4) Forest resources. The forest coverage rate of Shipiao Hot Spring area is 63.23%, the forest resources are rich, the natural vegetation rate is 75.62%, the artificial vegetation rate is only 24.38%, and the

effective green coverage area is 94.32%. Vegetation can effectively block strong ultraviolet rays at high altitude. the main vegetation distributed in this area are Phoenix tree, small leaf banyan, alpine banyan, jackfruit, Pinus elliottii, seven-leaf tree, Bauhinia, Magnolia officinalis and other naturally growing trees with large crown. Camphor, fragrant wood, soft-leaf sunflower, palm, Platycladus orientalis, Camellia oleifera, holly, plantain, star anise, leaf flower and other artificially planted landscape plants. The hot spring area is surrounded by green in summer and autumn, and the air is fresh, which is very suitable for mental cultivation, mood regulation, recreation and recuperation.

2.2.2 Spatial perception

Shipiao Hot Spring Resort is surrounded by mountains and water, and the visual richness and hierarchy of the landscape are good. In the public pool spring area, the encirclement degree is insufficient, and the privacy of the site is weak. The public color service area and the hot spring pool area have a good moving line, strong identification of regional features, smooth connection between space and space, and good accessibility.

2.2.3 Sensory experience

Natural hot spring bath: natural hot spring bath is the most important hot spring product of Shipiao Hot Spring Resort. There are 17 hot spring pools in Shipiao Hot Spring area, including 1 outdoor swimming pool with an area of 120 square meters, 5 outdoor bubble pools with an area of 9-12 square meters each, 2 indoor male's and female's naked hot spring pools with an area of about 60 square meters each, which is the main bath place for recuperators, and 8 hotel accommodation attached hot spring pools with an area of 4 square meters each.

Drinking therapy: in Shipiao Hot Spring, drinking therapy and bubble bath therapy are inseparable, there are three hot spring water drinking points, recuperators through daily drinking, tea, three meals of water and other ways to drink hot spring water for health and wellness.

Natural cave fumigation: natural cave fumigation is one of its famous hot spring health and wellness products. The temperature in the hot spring cave is kept at about 43 °C all the year round, and the recuperators enter it as if they had entered a natural sauna. In addition, there is head fumigation for head entry only, which plays a health and wellness effect on human face moisturizing and vision restoration.

2.2.4 Infrastructure

There are 1 hot spring accommodation, 3 rest pavilions, 1 comprehensive service area, 1 restaurant, and 1 garbage collection station.

3. Evaluation of rehabilitation factors

3.1. Evaluation method

Analytic hierarchy process (AHP) is a commonly used method for quantitative analysis of non-quantitative things. The reference of its combination of qualitative and quantitative, systematic and hierarchical characteristics in rehabilitation landscape research has been widely used and confirmed. In this study, the quality evaluation of health and wellness hot spring landscape is divided into three levels: target layer, criterion layer and index layer. According to the relative importance calibration, the relative importance values of 16 indexes are assigned by 20 experts engaged in landscape planning and design (5), rehabilitation landscape-related researchers (5) and graduate students (10), respectively,

and then imported into Yaahp10.1 software for batch processing, and finally obtained the weight results of each level of indicators (Table 2). As can be seen from Table 2, in the criterion layer, the order of weight from large to small is sensory experience (0.3873) > ecological environment (0.2748) > spatial perception (0.1981) > infrastructure (0.1398), indicating that the sensory experience brought about by landscape perception and the landscape environment of natural ecology are important factors affecting the evaluation of health and wellness hot spring landscape. Among the elements of ecological environment, the weight value of climate comfort is the highest, followed by forest quality, indicating that the natural climate of health and wellness hot spring landscape is more important. The comfort of the hot spring climate is the most important for the recuperators, and the good forest landscape environment is an important factor to improve the landscape quality, which can bring people physical and mental relaxation. Among the elements of spatial perception, the functional weight of the site is the highest, followed by the privacy of the site, indicating that it meets the diversified needs of the well-being and the privacy of sense of security, which determines whether the recuperators are willing to stay more in the landscape environment. Among the elements of sensory experience, the weight value of visual landscape is the highest, followed by tactile landscape. It shows that the visual perception of landscape color, ornamental characteristics, landscape artistic conception, touch texture and hot spring impact are more important in the construction of health and wellness hot spring landscape. Among the infrastructure elements, the weight value of leisure facilities is the highest, followed by recreation facilities, indicating that leisure space, resting space and recreation

platform are highly attractive to the well-being, and should be paid attention to in the infrastructure landscape elements.

The satisfaction score of each landscape evaluation index can be obtained through questionnaire survey, expert score and field measurement, and the comprehensive score of the index layer can be obtained by multiplying the satisfaction score of each index layer and the index weight value of the index layer. Then the comprehensive calculation model of health and wellness hot spring landscape quality, such as Eq. (1) to Eq. (5), A, B, C are the corresponding index items in Table 3.

$$A = B_1 + B_2 + B_3 + B_4 \quad (1)$$

$$B_1 = 0.4843C_1 + 0.1172$$

$$C_2 + 0.1678C_3 + 0.2307C_4 \quad (2)$$

$$B_2 = 0.3851C_5 + 0.2383C_6 + 0.1701C_7 + 0.2065C_8 \quad (3)$$

$$C_9 + 0.1539C_{10} + 0.3088$$

$$B_3 = 0.4536C_9 + 0.0837C_{10} + 0.1539C_{11} + 0.3088$$

$$C_{12} \quad (4)$$

$$B_4 = 0.2189C_{13} + 0.4198C_{14} + 0.2783C_{15} + 0.083$$

$$0C_{16} \quad (5)$$

Table 3 Evaluation index weight results

Target Layer	Criterion Layer	Weight Of Criterion Layer	Index Layer	Weight Of Index Layer	Ranking	Total Weight	Total Ranking
			Climate	0.4843	1	0.1331	2
			Comfort C ₁				
			Water Quality C ₂	0.1172	4	0.0322	14
	Ecological Environment B ₁	0.2748	Air Quality C ₃	0.1678	3	0.0461	9
			Forest Quality	0.2307	2	0.0634	5

			C₄			
			Venue Function C₅	0.385 1	1	0.076 3 4
			Venue Privacy C₆	0.238 3	2	0.047 2 8
	Spatial Perception B₂	0.198 1	Venue Accessibility C₇	0.170 1	4	0.033 7 12
Health And Wellness Hot Spring Landscape Evaluation Model A			Site Scale C₈	0.206 5	3	0.040 9 10
			Visual Landscape C₉	0.453 6	1	0.175 7 1
			Soundscape C₁₀	0.083 7	4	0.032 4 13
	Sensory Experience B₃	0.387 3	Olfactory Landscape C₁₁	0.153 9	3	0.059 6 6
	Infrastructure B₄	0.139 8	Tactile Landscape C₁₂	0.308 8	2	0.119 6 3
			Service Facilities C₁₃	0.218 9	3	0.030 6 15
			Leisure Facilities C₁₄	0.419 8	1	0.058 7 7
			Health And Wellness Facilities C₁₅	0.278 3	2	0.038 9 11
			Local Cultural Expression C₁₆	0.083 0	4	0.011 6 16

3.2. Comprehensive evaluation results of rehabilitation factors

Through the health and wellness hot spring landscape environment satisfaction questionnaire, the questionnaire refers to the design theory of supportive rehabilitation environment put forward by Roger Ulrich, an American scholar with high recognition in

rehabilitation landscape. An on-the-spot questionnaire survey is carried out from March to June in 2021. A total of 240 questionnaires are distributed and 226 valid questionnaires are filled out on the spot, with an effective rate of 94.17%. Among them, 62 persons are in need of recovery from illness, 78 persons are in need of health care, 57 persons are tourists, and 29 persons are on leisure and vacation; Gender: 117 females, 109 males; Age group: 12 persons younger than 18 years old, 92 persons 18-45 years old, 81 persons 46-69 years old, 41 persons older than 69 years old, reflecting the diversified characteristics of health care experience levels.

In order to display the evaluation results in a data format, the health and wellness hot spring landscape quality evaluation results are divided into 5 levels according to the 100-point system: Grade I (≤ 44 points), the landscape quality is extremely poor; Grade II (45-59 points), the landscape quality is poor; Grade III (60-74 points), the landscape quality is average; Grade IV (75-89 points), the landscape quality is good; Grade V (90-100 points), the quality of the landscape is very good. According to the comprehensive evaluation analysis (Table 4), the comprehensive evaluation score of Shipiao Hot Spring quality is 78.54 points, the landscape quality is Grade IV, and the landscape quality is relatively good. Among them, the quality of ecological environment (26.03 points) and the quality of sensory experience (28.21 points) are the dominant elements of Shipiao Hot Spring; while the spatial perception quality of the site is average, and infrastructure is a relatively lacking element in its construction.

Table 4 Comprehensive scores of the landscape quality of Shipiao Hot Spring

Criterion Layer	Weight Index Score	Weighted Layer Score	Average Score	Criterion Layer	Weight Index Score	Weighted Layer Score	Average Score		
Ecological Environment B ₁	26.03	Climate Comfort C ₁	100	48.43	Sensory Experience B ₃	28.21	Visual Landscape C ₉	78.6	35.65
		Water Quality C ₂	76.1	8.92			Soundscape C ₁₀	75.7	6.34
		Air Quality C ₃	87.4	14.67			Olfactory Landscape C ₁₁	57.4	8.83
		Forest Quality C ₄	98.4	22.70			Tactile Landscape C ₁₂	71.3	22.02
		Venue Function C ₅	77.6	29.88			Service Facilities C ₁₃	64.8	14.18
Spatial Perception B ₂	14.65	Venue Privacy C ₆	73.4	17.49	Infrastructure B ₄	9.65	Leisure Facilities C ₁₄	72.7	30.52
		Venue Accessibility C ₇	68.5	11.65			Health And Wellness Facilities C ₁₅	68.4	19.04
		Site Scale C ₈	72.4	14.95			Local Cultural Expression C ₁₆	63.4	5.26

In the comprehensive evaluation of eco-environmental quality, climate comfort C₁ and forest quality C₄ have higher scores. Shipiao Hot Spring area does little damage to the original ecological environment, preserving a large area of primitive forest and natural

forest, its valley topography is conducive to the maintenance of temperature and humidity, high-quality climatic conditions and forest environment provide good conditions for hot spring health and wellness. Because there are a large number of recuperators in Shipiao Hot Spring, the per capita health and wellness time is as long as 25 days, and the recuperators produce more domestic waste pollution, so the air quality C_3 and water quality C_2 are relatively low.

Site function C_5 has the highest score in the comprehensive evaluation of spatial experience quality. Shipiao Hot Spring function zone is clear, with special service and reception function area, hot spring health and wellness function area, health and wellness function area, health consultation function area, basically meet the diversified needs of all kinds of recuperators. There are 17 kinds of bubble pools in Shipiao Hot Spring, only some of them are equipped with certain plants or stones for private encirclement, while other rest places are open spaces, and the scale and proportion of landscape elements are generally dealt with, resulting in a slight deficiency in the quality of privacy C_6 and site scale C_8 of hot spring sites. The score of site accessibility C_7 is the lowest, the distance between the functional areas is far, the terrain is undulating, and the barrier-free design is not considered, so it is extremely inconvenient for recuperators to reach the destination in the site.

In the quality of sensory experience, the comprehensive scores of visual landscape C_9 and tactile landscape C_{12} are higher. Shipiao Hot Spring uses the setting of high and low bubble pools to form a more open view of the landscape, there are Phoenix wood, bauhinia, banyan, jackfruit and other plants with rich colors and high ornamental value, as well as other landscape sketches with various

colors. The hot spring area has a natural cave fumigation landscape, and at the same time uses the terrain to form a natural impact therapy, which not only has the visual sense of the waterfall, but also makes people get full tactile stimulation, in addition, in the pavement material, mosaics and pebbles with strong sense of concavity and convexity are selected for foot massage. The comprehensive scores of sound landscape C_{10} and olfactory landscape C_{11} are lower, mainly because there is no artificial sound scene in the hot spring area, and there is a lack of the use of aromatic plants.

In the infrastructure evaluation, the comprehensive score of leisure facility C_{14} is higher, mainly due to the relatively perfect construction of facilities such as pavilions, benches and leisure platforms in the hot spring area. Although the layout is still lacking, it accords with the principle of ergonomics and is comfortable to use. The scores of service facility C_{13} , health and wellness facility C_{15} and local culture C_{16} are lower, mainly because the service reception in hot spring area is better, but the lighting arrangement is unreasonable, the service radius of sanitary facilities is small, and there is a serious lack of publicity facilities; although there are fitness trails and health and wellness consultation platforms, the level of health and wellness consultation service is low, and there is a lack of well-equipped hot spring medical system. The hot spring area has only made a conceptual derivation of the form of "Shipiao". The number of scenic spots embodied in culture is relatively small, and a unique hot spring landscape cultural system has not been formed.

Conclusion

Based on grey statistical theory and Analytic hierarchy process (AHP), 16 evaluation indexes are selected from four aspects of

ecological environment, spatial perception, sensory experience and infrastructure to construct a comprehensive evaluation model of health and wellness hot spring landscape quality. Combined with the actual investigation, we have carried out a qualitative and quantitative landscape quality analysis of Shipiao Hot Springs, which enables the research scientific and objective, and provides a certain practical significance.

The results suggest that innate resources such as ecological environment and sensory experience are the advantages of Shipiao Hot Spring landscape, but there is a lack of spatial experience and infrastructure construction, that is, the shaping of humanized perceptual landscape still needs to be strengthened. Generally speaking, we should make rational use of idle space, refine functional zones, select landscape elements with appropriate scale and proportion, create a good private space, increase space functionality and interest, and improve internal traffic. We should make good use of plant elements, enhance color richness, and reasonably arrange health and wellness plants combined with hot spring water landscape, increase the utilization rate of health and wellness plants, and give full play to the maximum benefit of the combination of plants and smell. In addition, it is also a good measure to enhance the artificial music landscape design, which helps to make use of the pleasant sounds of nature, and introduce the audible, meltable, collectable and accessible sounds into the health and wellness environment. Finally, the service facility system should be improved, and local culture should be integrated into all aspects of the landscape. For example, we may introduce formal medical institutions, actively sum up the experience of private health care, distinguish the population, treat them according to

classification, and scientifically carry out hot spring health and wellness.

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