Comprehensive evaluation of forest health consumption satisfaction based on analytic hierarchy process and fuzzy comprehensive evaluation method

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Abstract. In order to explore the current situation of consumer perception satisfaction of forest health industry service supply in the aging market of the three northeastern provinces, in order to further help the forest health industry in the three northeastern provinces to expand and optimize the aging market. This paper uses the questionnaire survey method to collect the questionnaire among the elderly population in the three northeastern provinces and the expert group in the field of forest health. Among them, 587 valid questionnaires for the elderly population are recovered, and the effective rate of the questionnaire is 96.23 %. In view of the questionnaire index data, this paper first calculates the index weight of the 10 expert evaluation questionnaire data by AHP analytic hierarchy process, and then combines the evaluation weight of the index to deal with the index satisfaction of the elderly population, and calculates the FCE fuzzy comprehensive evaluation score of satisfaction. Next, through the comparative analysis of the index importance-satisfaction ranking, further analyzes the supply and demand development status of forest health industry service supply index in the aging market. The results show that the evaluation weights of the first-level indicators are as follows : medical care (0.4464) > infrastructure (0.4226) > leisure and entertainment (0.1310). The lowest satisfaction score of the target layer, 3 factor layers and 15 index layers was 74. 69, and the highest score was 79. 66, and each layer was in a good stage at this stage. At present, nine indicators, including basic accommodation services, public service facilities, accommodation, commercial shopping areas, folk custom activities, tourism vacations, forest health lectures and forest health and recuperation cultural centers, are higher than the evaluation of consumer satisfaction, which belongs to the category of ' advantage maintenance '. For its indicators, there is a certain degree of development lag and other issues, belongs to the ' continuous reform ' indicators. Finally, based on the research conclusion, this paper discusses the optimization of the service supply of the aging market of forest health industry in the three northeastern provinces and the effective improvement of the satisfaction of the elderly population with the consumption of the evaluation index, and puts forward policy implications.

Key words: AHP analytic hierarchy process; fuzzy comprehensive evaluation; forest health; aged population in three northeastern provinces; satisfaction evaluation.

1. Introduction

With the improvement of people ' s living standards and the deepening of aging, the reform and upgrading of the pension industry needs to be solved. According to the seventh census, the proportion of the elderly population in the three eastern provinces reached 16.39 %, far higher than the national average. At present, the health care industry, as the core of the " silver economy, " bears the responsibility of alleviating the impact of aging on social economy. However, under the background of the rapid development of the new health care industry with the integration of medical care, tourism, health care and other industries, the traditional pension industry cannot well coordinate the contradiction between the supply of health care industry and the growing demand for aging. Such an unbalanced supply-demand relationship in the ageing market is challenging the entire ageing system market. The " Notice on Promoting Forest Experience and Forest Health Development " issued by the State Forestry Administration pointed out that it is necessary to provide targeted health services for residents while carrying out general leisure and entertainment activities. In particular, it is necessary to combine the diversified health needs of middle-aged and elderly people to build a forest

health system integrating food, housing, transportation, tourism, entertainment and culture, sports, health care and medical care. Forest health industry was born in Germany in the 1940 s, China is still in the exploration and development stage. Forest health is a series of activities beneficial to physical and mental health through the combination of forest resources and modern medical treatment. At the same time, the connotation of forest health is expounded as ' forest-based, people-oriented, maintenance-oriented, and health-oriented. '[1] Northeast forest region is the key forest region in China, accounting for 37 % of the total forest area in China, with good forest resource endowment. There are three theories of forest health industry : one is forest medicine theory. Studies have shown that forests have the functions of disease prevention. Second, the theory of restorative environment. Forests have a good decompression effect on people. The third is the theory of sustainable development. It can effectively help the sustainable utilization of green water and green mountains.[2] Based on the supply and demand theory, this paper collects the consumption satisfaction assignment data of the forest health index system of the elderly population in the three eastern provincial capitals by issuing questionnaires.

The innovation of this paper is mainly reflected in two aspects. First, the eastern three provinces with the highest aging rate are selected as the survey scope, so that the survey results are more representative. The analytic hierarchy process is innovatively introduced to design the expert index evaluation questionnaire, and two evaluation data from the elderly population and experts are obtained. Secondly, the index weight calculation and satisfaction fuzzy comprehensive evaluation are carried out based on the two data, and the satisfaction scores of each level and each index sample are output. Secondly, the " importance – satisfaction " is used for comparative analysis based on ranking, and the development status and industrial structure of specific indicators of forest health in the three northeastern provinces are analyzed. Finally, according to the empirical results, the conclusions of this paper are drawn, and relevant policy implications are obtained after discussion.

2. Research Method

This paper combines AHP analytic hierarchy process and fuzzy comprehensive evaluation method to quantitatively analyze the satisfaction evaluation status of the elderly population in the three northeastern provinces. According to the comparative analysis of evaluation weight ranking and hierarchy satisfaction ranking, it is concluded that the ' advantage maintenance ' index and the ' continuous reform ' index. Through the quantitative analysis of the two kinds of indexes, the supply and demand development status of forest health industry in the aging market in the three northeastern provinces is analyzed.

2.1 AHP analytic hierarchy process evaluation index weight acquisition

AHP analytic hierarchy process was first proposed by Professor T. L. Saaty, a famous American operational researcher, in the early 1970s. Through the combination of quantitative and qualitative, the target schemes of each layer are compared, and the weight value is obtained to determine the optimal scheme. In this study, the data of expert evaluation indexes can be processed through the application of analytic hierarchy process. Then to calculate the northeast three provinces elderly population forest health consumption satisfaction influencing factors index total weight and sorting. There are four steps :

The first step : according to the research purpose and evaluation index, the index hierarchy, to build AHP hierarchy analysis framework. where, (evaluation) the target layer is represented by A ; the three (evaluation) factor levels are respectively represented as the supply of infrastructure services (B_1), the supply of leisure and entertainment services (B_2), and the supply of medical and health services (B_3), which constitute the first-level indicators ; the secondary indicators are composed of 15 indicators in the evaluation index layer ($C_1 - C_{15}$).

The second step: the influence factors between the same level according to the importance of pairwise comparison score (9 points scale method), through the production of an expert index

evaluation questionnaire to collect the data of each layer index comparison score. Thus construct judgment matrix A, B1, B2, B3. Evaluation criteria such as table 1. The judgment matrix of each layer calculated by the weight results is obtained by averaging the judgment matrix of each layer corresponding to each expert.

Table 1. Evaluation Criteria

Evaluation score	The evaluation level is compared to two or two at the same level
9	Absolutely important
7	Very important
5	More important
3	Slightly more important
1	Equally important
8, 6, 4, 2	Between the two adjacent levels in turn

The third step: calculate the weight results, and check the consistency of each layer judgment matrix. The feature vectorω, such as formula (1), is solved by the normalized summation of each judgment matrix.

$$\omega=\{\omega_1,\omega_2,\ldots,\omega_n\} \tag{1}$$

$$\lambda_{\max}=\frac{1}{n}\sum_{i=1}^{n}\frac{\left(A_i\omega\right)_i}{\omega_i} \tag{2}$$

$$CI=\frac{\lambda_{\max}-n}{n-1} \tag{3}$$

$$CR=\frac{CI}{RI} \tag{4}$$

According to the formula (2) (3), the calculation results of $\lambda_{\max}$ and CI are obtained. Among them, A_i in (2) represents the evaluation matrix of the target layer and three element layers respectively, and n in (3) represents the order of the matrix. In the consistency test of analytic hierarchy process, when the order of judgment matrix is from 3 to 10, the corresponding value of average random consistency index RI is 0.58, 0.89, 1.12, 1.36, 1.41, 1.46, 1.49. Finally, according to the formula (4), the consistency ratio CR is obtained, and the consistency of the judgment matrix is tested. That is, when CR < 0.1, the matrix is considered to have good consistency.

2.2 Fuzzy comprehensive evaluation of satisfaction (FCE)

Fuzzy comprehensive evaluation method (FCE) is based on fuzzy mathematics theory. It can effectively carry out quantitative analysis on some problems that are difficult to be quantitatively analyzed and the boundary is fuzzy, and it is mainly used for comprehensive evaluation. Using AHP analytic hierarchy process alone, there will be human evaluation errors and other factors in the process. AHP and FCE are combined to construct a comprehensive evaluation system. It can effectively improve the scientificity and accuracy of decision-making results, and is more convenient for evaluation and comparison. In this study, the fuzzy comprehensive evaluation system of forest health consumption satisfaction in the three northeastern provinces is constructed. In this study, the following steps are taken :

The first step : to determine the evaluation index factor set U. The factor sets of the target layer and the factor layer are shown in formula (5) and (6), respectively.

$$U_A=\{U_{B1},\ U_{B2},\ U_{B3}\} \tag{5}$$

$$U_{Bi}=\{U_{c1},\ U_{c2},...,U_{cf}\} \tag{6}$$

The second step : determine the comment set V as shown in (8). Delegate in turn, fail, pass, medium, good, excellent, and give the five rating scores.

$$V = \{V_1, V_2, V_3, V_4, V_5\} \tag{7}$$

The third step : Determine satisfaction membership evaluation matrix and fuzzy comprehensive evaluation set. The data of the five-level satisfaction scale at the factor level and the index level are collected through the questionnaire, and the sample frequency of each index at the index level is calculated, namely, the evaluation membershipR_{ij}. According to the factor set, the membership evaluation matrixR_i is constructed, and the element layer membership evaluation matrix(B_i) is constructed. Finally, the fuzzy comprehensive evaluation set of each layer is calculated by combining theω^T obtained from AHP analytic hierarchy process. The fuzzy comprehensive evaluation set of the factor layer is B_i,(i=1,2,3), and the fuzzy comprehensive evaluation set of the target layer is expressed by T, as shown in formula (8) and (9).

$$B_i = \omega_{ij}^T \times R_i \tag{8}$$

$$T = \omega^T \times (B_i) \tag{9}$$

The fourth step : calculate the satisfaction fuzzy comprehensive evaluation score. For the target layer, factor layer and index layer, the comprehensive evaluation score is calculated according to Equation (10) combined with the score column vector of the comment set. Among them, F_A, F_B, F_C are three levels of satisfaction fuzzy comprehensive evaluation scores.

$$F_A = T \times \begin{pmatrix} 20 \\ 40 \\ 60 \\ 80 \\ 100 \end{pmatrix} \quad F_B = B_i \times \begin{pmatrix} 20 \\ 40 \\ 60 \\ 80 \\ 100 \end{pmatrix} \quad F_c = R_{ij} \times \begin{pmatrix} 20 \\ 40 \\ 60 \\ 80 \\ 100 \end{pmatrix} \tag{10}$$

2.3 Comparative analysis of index attention – satisfaction

'Pay attention-satisfaction ' comparative analysis, that is, through the relationship between the attention of experts in the early stage and the satisfaction of consumers ' consumption perception in the later stage, the development status of indicators in the market system can be clearly reflected, and the evaluation criteria can be tested. Specifically, through the quantitative processing of the index at the same level, the comparative analysis of the degree of attention and satisfaction of the index can be carried out : when the evaluation degree of attention is higher than the satisfaction of consumption perception, it is said that the quality of service supply of such indicators in the market at this stage is not high, and it is necessary to focus on improvement and governance, as ' continuous reform ' indicators ; however, when the quantitative value of satisfaction is equal to or higher than the degree of attention, it indicates that the development path and form of indicators at this stage have certain convergence and high market vitality with the development direction of the market. While maintaining the advantages, we should continue to explore and develop based on the principle of maximizing consumer satisfaction. Belongs to ' advantage retention ' indicators. In this study, the total weight ranking of evaluation index experts and the total ranking of aging sample satisfaction score are compared and analyzed. This can provide a quantitative basis for the adjustment of the service supply structure of the forest health and elderly population market and the formulation of policies.

3. Data Source and Index System Construction

In order to make a better quantitative evaluation of the satisfaction of the elderly population in the three northeastern provinces on the existing forest health care industry service supply projects, this paper constructs the index system and distinguishes the hierarchical system of forest health care industry service supply, and collects the sample data of elderly consumers and expert evaluation

combined with questionnaire survey. Finally, on this basis, combined with the above research methods of analytic hierarchy process (AHP) and fuzzy comprehensive evaluation analysis, to select the model variables and measurement indicators required by the model.

3.1 Data sources

This study collects data by questionnaire. In the early stage, literature analysis was used to analyze the current situation of forest health service supply and the social characteristics of the elderly population's consumer groups, and a questionnaire on the satisfaction degree of the elderly population's forest health service supply and consumption in the three eastern provinces was produced. At the same time, the sample area is stipulated in the capital cities of the three eastern provinces, Harbin, Shenyang and Changchun. After a month of questionnaire collection, a total of 610 questionnaires were collected, of which 587 were valid, with an effective rate of 96.23 %. The high efficiency of the questionnaire provides a certain guarantee for improving the overall credibility of the sample inference. In addition, according to the index system constructed in 2.1, an expert index evaluation questionnaire is produced. Invites a group of experts, including universities, forest health base administrators and scholars or experts with rich research experience in forest health-related industries, to complete the questionnaire. A total of 10 valid questionnaires for expert index evaluation were collected.

3.2 construction of index system

Table 2. Indicators and Variable Settings

dimensional	Name of indicator	observation problems	variable configuring
Infrastructure services supply	Basic accommodation services	Q : Please score the consumer satisfaction and emphasis degree of each item in the basic service part of forest health according to the previous consumer experience.	X_1
	Leisure entertainment and pension facilities		X_2
	Basic catering services		X_3
	Traffic convenience inside and outside scenic area		X_4
	safety program		X_5
	public service facilities		X_6
Leisure entertainment service supply	homestay inn	Q : According to your previous consumption experience, please score the consumer satisfaction and emphasis degree of each item in the auxiliary construction part of forest health and maintenance, such as cultural entertainment, tourism and leisure.	X_7
	Commercial shopping area		X_8
	Folklore Characteristic Activities		X_9
	Forest walking		X_{10}
	tourism resort		X_{11}
Medical care service supply	Forest sports rehabilitation	Q : Please score the consumer satisfaction and emphasis degree of each item in the medical service part of forest health based on the previous consumer experience.	X_{12}
	Forest health lecture		X_{13}
	Forest rehabilitation training		X_{14}
	Forest Health Culture Center		X_{15}

In order to fully and comprehensively reflect the satisfaction of the elderly consumers to the forest health service industry and construct a scientific and reasonable index system consistent with the model, this paper selected the evaluation index of forest health service industry according to the method of theoretical research and framework model construction, combined with relevant literature [3,4,5] and expert opinions, and then constructed the index system of this paper and completed the questionnaire design. Finally, the questionnaire was put on the Internet and the data were collected. This paper divides the evaluation index system of forest health service into three dimensions, consisting of 15 indicators. In the dimension of infrastructure service supply, the quality of infrastructure service is mainly manifested in accommodation, catering, entertainment, transportation

and so on. Therefore, in this part, six evaluation indexes are selected, including basic accommodation service, leisure and pension facilities, basic catering service, traffic convenience inside and outside the scenic area, safety planning, and public service facilities. In the leisure entertainment service supply entertainment dimension, the leisure entertainment service mainly includes the characteristic accommodation, the folk custom activity, the shopping tourism and so on, therefore in this part selects the lodging, the commercial shopping area, the folk custom characteristic activity, the forest walks, the traveling vacation these five targets. In the dimension of medical rehabilitation service supply, the level of medical rehabilitation is mainly manifested in disease prevention, knowledge popularization and medical environment. Therefore, four indicators of forest sports rehabilitation, forest health lecture, forest rehabilitation training and forest health culture center are selected, as shown in table 2.

4. Results and Analysis

After completing the questionnaire collection and collation of the elderly population and the expert group in the three northeastern provinces, the reliability and validity of the survey data are analyzed to test the quality of the questionnaire data. Combined with the analysis of the research methods of analytic hierarchy process and fuzzy comprehensive evaluation method, the index data required by the model method are selected to evaluate the satisfaction of the elderly population in the three northeastern provinces with forest health and consumption. In summary, the empirical results are obtained.

4.1 Reliability and Validity Analysis

Reliability analysis is a basic test for reliability test in questionnaire survey. Measured by the value of Cronbach ' s α (reliability coefficient), it is generally believed that the reliability of the questionnaire is good when the reliability coefficient is between 0.8 and 0.9. In this paper, SPSS23.0was used to calculate the reliability coefficient of587valid questionnaires (' very dissatisfaction = 1 ', ' dissatisfaction = 2 ', ' general = 3 ', ' satisfaction = 4 ', ' very satisfaction = 5 '). The Cronbach ' s alpha was0.857, which was greater than0.8. Therefore, the reliability test showed that the reliability of the questionnaire was high.

For the validity analysis, the KMO index is commonly used in statistics. When the KMO value is greater than 0.8, the questionnaire has good validity. The same questionnaire index satisfaction scale assignment data using SPSS23.0 to calculate the KMO index value, the KMO value of satisfaction data in this paper is 0.851, (> 0.85). In addition, based on the Bartlett ball test, the Sig values were significant (Sig = 0.000, Sig < 0.05). In summary, it is considered that the validity test is suitable for factor analysis.

4.2 AHP analytic hierarchy process index evaluation weight acquisition

Based on the data of 10 valid expert index evaluation questionnaires collected from universities, forest health base administrators and expert groups with rich research experience in forest health related industries, the corresponding values of the judgment matrix are calculated and tested by yaahp12.7, and the results are shown in table 3. Finally, the weight values of each layer in the AHP analytic hierarchy model of forest health consumption satisfaction of the elderly population in the three northeastern provinces are output, as shown in table 4.

Table 3. Determine the matrix eigenvalues, eigenvectors, and consistency test results

matrix	Eigenvectors ω	λ_{max}	CI	RI	CR	Conformance check
A	0.4226, 0.1310, 0.4464	3.0163	0.0091	0.58	0.0157	past muster
B_1	0.2219, 0.2004, 0.2650, 0.1400, 0.1080, 0.0646	6.3064	0.0433	0.89	0.0486	past muster
B_2	0.0911, 0.0421, 0.1860, 0.4855, 0.1953	5.2364	0.0665	1.26	0.0528	past muster
B_3	0.4893, 0.1261, 0.2118, 0.1728	4.0522	0.0231	1.18	0.0196	past muster

The feature vector value ω and maximum eigenvalue λ_{max} of the corresponding judgment matrix A and B_i in the target layer and the element layer can be obtained by processing the expert index score data by yaahp12.7. The feature vectors of each layer are :

$$\omega^T = (0.4226 \quad 0.1310 \quad 0.4464)^T$$
$$\omega_{1j}^T = (0.2219 \quad 0.2004 \quad 0.2650 \quad 0.1400 \quad 0.1080 \quad 0.0646)^T$$
$$\omega_{2j}^T = (0.0911 \quad 0.0421 \quad 0.1860 \quad 0.4855 \quad 0.1953)^T$$
$$\omega_{3j}^T = (0.4893 \quad 0.1261 \quad 0.2118 \quad 0.1728)^T$$

At the same time, the size of the consistency test index CR of the matrix is obtained, and the CR value is compared with RI to test whether the results of the evaluation of the indicators are consistent. Table 3 shows that the corresponding CR values of judgment matrix A and B_i are better (all less than 0.1). Therefore, this AHP model passes the consistency test and has good consistency. It provides certain guarantee for the credibility of subsequent analysis results.

Table 4. Weight calculation results of AHP analytic hierarchy process model for forest health consumption satisfaction of the elderly population in three northeastern provinces

Evaluate the target layer	Evaluation element layer	weight	Evaluation indicator layer	Total weight	Sort the total weights
Evaluation of satisfaction with forest health care consumption of the elderly population in the three northeastern provinces(A)	Satisfaction with the supply of infrastructure services (B_1)	0.4226	Basic accommodation services (C_1)	0.0938	4
			Leisure and entertainment and elderly care facilities (C_2)	0.0847	5
			Basic catering services (C_3)	0.1120	2
			Convenient transportation inside and outside the scenic spot (C_4)	0.0592	8
	Satisfaction with the supply of leisure and entertainment services (B_2)	0.1310	Security planning (C_5)	0.0457	10
			Public service facilities (C_6)	0.0273	11
			Homestay (C_7)	0.0119	14
			Commercial shopping area (C_8)	0.0055	15
			Folklore special events (C_9)	0.0244	13
			Forest walks (C_{10})	0.0636	7
			Travel and vacation (C_{11})	0.0256	12
	Satisfaction with the supply of medical and health care services (B_3)	0.4464	Forest sports rehabilitation (C_{12})	0.2184	1
			Forest Health Lecture Hall (C_{13})	0.0563	9
			Forest rehabilitation (C_{14})	0.0945	3
			Forest Wellness Cultural Center (C_{15})	0.0771	6

The model has good consistency, and the output index weight value is shown in table 4. Through observation, it is not difficult to see that the weight of infrastructure and medical care satisfaction in the factor level analysis evaluation (all greater than 0.4) is better than the evaluation weight of leisure and entertainment service supply satisfaction (0.1310). In terms of the ranking of the weights of the second-level indicators, 90 % of the top ten indicators are distributed in the two first-level indicators of infrastructure and medical and health service supply, but the last four indicators are all located in the first-level indicators of leisure and entertainment service supply.

4.3 Fuzzy comprehensive evaluation system

4.3.1 Establish a set of evaluation indicator factors

Through the statistics of the five-level score frequency of the index layer in 587 valid questionnaires, the results are shown in Table 5, which is convenient for frequency calculation and

the membership evaluation matrix R_i of the index layer is constructed. Aiming at the level and index rating, the evaluation index factor set U is established, and four index factor sets of target layer and factor layer are established respectively, as shown in formula (11) (12) (13) (14).

$$U_A=\{U_{B1},\ U_{B2},\ U_{B3}\} \tag{11}$$

$$U_{B1}=\{U_{C1},\ U_{C2},\ U_{C3},\ U_{C4},\ U_{C5},\ U_{C6}\} \tag{12}$$

$$U_{B2}=\{U_{C1},\ U_{C2},\ U_{C3},\ U_{C4},\ U_{C5}\} \tag{13}$$

$$U_{B3}=\{U_{C1},\ U_{C2},\ U_{C3},\ U_{C4}\} \tag{14}$$

Table 5. Statistical table of time-sharing frequency of questionnaire index satisfaction

Evaluation element layer	Evaluation indicator layer	Very dissatisfied	dissatisfied	medium	satisfied	Very satisfied
Satisfaction with the supply of infrastructure services (B_1)	Basic accommodation services (C_1)	4	23	88	340	142
	Leisure and entertainment and elderly care facilities (C_2)	3	34	178	216	156
	Basic catering services (C_3)	0	33	184	236	134
	Convenient transportation inside and outside the scenic spot (C_4)	3	36	166	270	112
	Security planning (C_5)	4	27	184	261	111
Satisfaction with the supply of leisure and entertainment services (B_2)	Public service facilities (C_6)	3	41	143	253	147
	Homestay (C_7)	5	15	122	288	157
	Commercial shopping area (C_8)	2	26	154	258	147
	Folklore special events (C_9)	4	16	160	260	147
	Forest walks (C_{10})	0	35	198	242	112
	Travel and vacation (C_{11})	1	35	164	261	126
Satisfaction with the supply of medical and health care services (B_3)	Forest sports rehabilitation (C_{12})	9	24	112	280	162
	Forest Health Lecture Hall (C_{13})	2	37	159	262	127
	Forest rehabilitation (C_{14})	4	33	141	258	151
	Forest Wellness Cultural Center (C_{15})	1	33	151	245	57

4.3.2 Create a comment set

The comment set is determined according to $V=\{V_1\ \ V_2\ \ V_3\ \ V_4\ \ V_5\}$. In this study, according to the empirical rule, the score of the comment set is determined according to the score interval shown in Table 6.

Table 6. Scores of Comment Sets

Failed	pass	medium	good	outstanding
(0 , 20)	(20 , 40)	(40 , 60)	(60 , 80)	(80 , 100)

4.3.3 Establish a membership evaluation matrix and a fuzzy comprehensive evaluation set

Based on the statistics of the score frequency of index satisfaction, the score frequency of 587 valid sample groups is calculated, namelyR_{ij}. Based on this, the evaluation matrix R_i of index membership degree of three factor layers is constructed. Finally, the fuzzy comprehensive evaluation setB_i of each element layer is obtained by multiplying the membership evaluation matrix and the weight vector of each layer. The fuzzy comprehensive evaluation set T of the target layer is the product of ω^T and matrix (B_i).

(1)"Infrastructure Service Supply" Affiliation Evaluation Matrix R_1:

$$R_1=\begin{pmatrix}0.0068 & 0.0392 & 0.1499 & 0.5792 & 0.2249\\ 0.0051 & 0.0579 & 0.3032 & 0.3680 & 0.2658\\ 0 & 0.0562 & 0.3135 & 0.4020 & 0.2283\\ 0.0051 & 0.0613 & 0.2828 & 0.4600 & 0.1908\\ 0.0068 & 0.0460 & 0.3135 & 0.4446 & 0.1891\\ 0.0051 & 0.0699 & 0.2436 & 0.4310 & 0.2504\end{pmatrix}$$

$$B_1=\omega_{1j}^T\times R_1=(0.2219\quad 0.2004\quad 0.2650\quad 0.1400\ 0.1080\quad 0.0646)^T\times R_1$$

$$= (0.0043 \quad 0.0533 \quad 0.2663 \quad 0.4491 \quad 0.2270)$$

(2)"Leisure and entertainment service supply" affiliation evaluation matrix R_2:

$$R_2 = \begin{pmatrix} 0.0085 & 0.0256 & 0.2078 & 0.4906 & 0.2675 \\ 0.0034 & 0.0443 & 0.2624 & 0.4395 & 0.2504 \\ 0.0068 & 0.0273 & 0.2726 & 0.4429 & 0.2504 \\ 0 & 0.0596 & 0.3373 & 0.4123 & 0.1908 \\ 0.0017 & 0.0596 & 0.2794 & 0.4446 & 0.2147 \end{pmatrix}$$

$$B_2 = \omega_{2j}^T \times R_2 = (0.0911 \quad 0.0421 \quad 0.1860 \quad 0.4855 \quad 0.1953)^T \times R_2$$
$$= (0.0025 \quad 0.0499 \quad 0.2990 \quad 0.4326 \quad 0.2160)$$

(3)"Medical and health care service supply" affiliation evaluation matrix R_3:

$$R_3 = \begin{pmatrix} 0.0153 & 0.0409 & 0.1908 & 0.4770 & 0.2760 \\ 0.0034 & 0.0630 & 0.2709 & 0.4463 & 0.2164 \\ 0.0068 & 0.0562 & 0.2402 & 0.4395 & 0.2573 \\ 0.0017 & 0.0562 & 0.2572 & 0.4174 & 0.2675 \end{pmatrix}$$

$$B_3 = \omega_{3j}^T \times R_3 = (0.4893 \quad 0.1261 \quad 0.2118 \quad 0.1728)^T \times R_3$$
$$= (0.0096 \quad 0.0496 \quad 0.2228 \quad 0.4549 \quad 0.2631)$$

(4)In summary, the fuzzy comprehensive evaluation set Tof the target layer A is calculated:

$$T = \omega^T \times \begin{pmatrix} B_1 \\ B_2 \\ B_3 \end{pmatrix} = (0.4226 \quad 0.1310 \quad 0.4464)^T \times \begin{pmatrix} B_1 \\ B_2 \\ B_3 \end{pmatrix}$$
$$= (0.0064 \quad 0.0512 \quad 0.2512 \quad 0.4495 \quad 0.2417)$$

4.3.4 Calculate the satisfaction fuzzy composite evaluation score

Table 7. Satisfaction Fuzzy Evaluation Scores

Evaluate the target layer	Satisfaction rating score	Evaluation element layer	Satisfaction rating score	Evaluation indicator layer	Satisfaction rating score	Score ranking
Evaluation of satisfaction with forest health care consumption of the elderly population in the three northeastern provinces(A)	77.38	Satisfaction with the supply of infrastructure services (B_1)	76.82	Basic accommodation services (C_1)	79.52	2
				Leisure and entertainment and elderly care facilities (C_2)	76.63	10
				Basic catering services (C_3)	76.05	12
				Convenient transportation inside and outside the scenic spot (C_4)	75.40	13
				Security planning (C_5)	75.26	14
				Public service facilities (C_6)	77.03	9
		Satisfaction with the supply of leisure and entertainment services (B_2)	76.19	Homestay (C_7)	79.66	1
				Commercial shopping area (C_8)	77.78	6
				Folklore special events (C_9)	78.06	4
				Forest walks (C_{10})	74.69	15
				Travel and vacation (C_{11})	76.22	11
		Satisfaction with the supply of medical and health care services (B_3)	78.25	Forest sports rehabilitation (C_{12})	79.15	3
				Forest Health Lecture Hall (C_{13})	77.62	8
				Forest rehabilitation (C_{14})	77.69	7
				Forest Wellness Cultural Center (C_{15})	77.86	5

Based on fuzzy mathematics theory, the satisfaction score of each layer is calculated separately. Combined with the fuzzy comment sets at all levels constructed above, the matrix product is carried out by using the weight vector T of the target layer, the weight vector $B_i$of the factor layer, and the five-level score frequency membership vector R_{ij} of the 15 indicators of the index layer and the fuzzy comment set according to Equation (10), namely, the calculation of the satisfaction fuzzy evaluation score. The results are shown in Table 7.

Through the calculation of fuzzy comprehensive evaluation of satisfaction, as shown in table 7. It is found that the satisfaction evaluation score of forest health consumption of the elderly population in the three northeastern provinces is 77.83, which is in a good stage. In addition, the satisfaction of 15 evaluation indexes in the three factor layers and the evaluation index layer is within the range of 60 and 80, and the corresponding comment set is also at a good level.

4.4 Comparative analysis of metrics and satisfaction

In this section, the basis for quantifying the same level of indicators is the ranking of the total weight of the evaluation of indicators and the ranking of satisfaction scores. By comparing the two rankings of the same index and the degree of gap (the smaller the ranking is, the better the market development status of the index in this dimension is), we analyze the market status of index attention – satisfaction. At the same time, this part of the analysis can also help to provide market basis for the adjustment of the index structure of forest health industry at the present stage.

(1) Among the six secondary indicators of the infrastructure service supply layer, the ranking of consumption satisfaction of the elderly population in the three northeastern provinces is better than the ranking of evaluation importance only with the two secondary indicators of basic accommodation service and public service facilities. At present, the two indicators have high market recognition, and the market response is in line with the development direction of the indicators. In terms of the four indicators, there is a large gap between the evaluation emphasis of basic catering services and the satisfaction of consumption perception at the present stage. There are some problems in the development of indicators at this stage, and there is a wide space for its development and correction.

(2) Among the five secondary indicators in the supply layer of leisure and entertainment services, only one indicator of forest walking pays less attention than consumer perception satisfaction. And there is a big gap between the two at this stage. The satisfaction of the four indicators is much higher than that of attention, and the development trend is good. In addition, at present, the attention and satisfaction of tourism vacation are basically the same. Breaking through the comfort status of the development of indicators is the most effective development measure for the further development of tourism vacation.

(3) For the four secondary indicators in health care. As the characteristic service output of forest health care industry different from traditional health care industry, breaking through traditional industry barriers and improving market awareness and acceptance are the primary tasks. In terms of the comparative analysis of attention and satisfaction, the attention and satisfaction of the four indicators are in a good state in both dimensions (rankings are higher), and the gap is not large. Among them, the satisfaction of forest sports and forest rehabilitation training is lower than that of attention, and gradual and in-depth development is the primary measure to improve the market flexibility and acceptance of such indicators. At the same time, focus on strengthening publicity and guidance, overall consideration of the characteristics of the output, efficient build ' forest health ' brand effect, to help the steady development of forest health industry status.

5. Conclusions, discussions and suggestion

Under the background of serious aging trend, the three northeastern provinces have continuously widened the boundary of the aging market and removed a large demand side for the silver-development economic belt. Different from the traditional rehabilitation projects, the benefits of forest rehabilitation depend on the factors released in the forest resources environment. Facing the

superior forest resources advantages of the three northeastern provinces. In this paper, 587 valid questionnaires of elderly consumers and 10 expert evaluation questionnaires were effectively processed. AHP analytic hierarchy process and fuzzy comprehensive evaluation method were used to comprehensively evaluate the satisfaction of the elderly population in the three northeastern provinces on the consumption of forest health industry at this stage. Finally, the rankings of the weight of 15 indicators and satisfaction evaluation at each level are compared. Through the discussion of the conclusion of the method, further policy implications are put forward from the three aspects of indicator development, the elderly population and relevant institutional departments.

5.1 Conclusion

5.1.1 Index evaluation weight acquisition based on AHP analytic hierarchy method

Based on the analytic hierarchy process, this paper draws the following conclusions : (1) The satisfaction of medical rehabilitation service supply accounts for the highest weight of 44.64 % in the three elements. Forest sports rehabilitation (0.2184), forest rehabilitation training (0.0945), forest health and recuperation culture center (0.0771) and forest health and recuperation health lecture hall (0.0563) are ranked in the top ten of the total weight of the index in the order of 1,3,6 and 9. (2) The weight of infrastructure service supply satisfaction factor layer is 42.66 %, which ranks second in the three factor layers. In the corresponding index layer, the six indicators of $C_1 - C_6$ are ranked in the top ten except the total weight of public service facilities (C_6). According to the total weight, the basic accommodation services (0.1120), basic catering services (0.0938), recreational and pension facilities (0.0847), traffic convenience inside and outside the scenic area (0.0592), safety planning (0.0457), public service facilities (0.0273) ; (3) The proportion of recreational service supply satisfaction is only 13.10 %. For the smallest proportion of the three elements layer, the index layer contains five indicators in the total weight ranking in addition to forest walking ranked 7th (0.0636), the four indicators of tourism vacation (0.0256), folk activities (0.0244), homestay (0.0119) and commercial shopping area (0.0055) are the last 15 secondary indicators.

5.1.2 Consumer satisfaction calculation based on fuzzy comprehensive evaluation method

Through the study of fuzzy evaluation of satisfaction, it is found that the evaluation score of forest health satisfaction of the elderly population in the three northeastern provinces at this stage is 77.38 points. Compared with the comment set, it is at a good level, and the scores of the three factor layers are medical health service supply satisfaction (78.25), infrastructure service supply satisfaction (76.82) and leisure and entertainment service supply satisfaction (76.19), which are also located in the interval of the comment set (60,80) and at a good level.

5.1.3 Comparative analysis based on attention-satisfaction rankings

Through the comparative analysis of the degree of importance and satisfaction, it is found that the consumer satisfaction of nine indicators, including basic accommodation services, public service facilities, accommodation, commercial shopping areas, folk custom activities, tourism vacations, forest health and recuperation lectures and forest health and recuperation cultural centers, is higher than that of evaluation importance. At present, the market has a high acceptance of these indicators, and the development direction is consistent with the market trend, which belongs to the category of ' advantage maintenance ' ; for its indicators, there is a certain degree of development lag and other issues, belongs to the ' continuous reform ' indicators.

5.2 Discuss

(1) This paper finds that the elderly consumers ' satisfaction with the supply of medical and health services in the three northeastern provinces occupies the largest weight in the factor level analysis and evaluation, and the supply of medical and health services is at the core position in the development of forest health industry. The supply of health care service itself is the core output of the characteristic and essentialization of forest health care. Therefore, under the premise of ensuring

the medical effect, it is essential to maximize the benefit of the " forest health factor " and let the elderly consumer get a more realistic " health care " service experience.

(2) This paper also found that leisure entertainment service supply satisfaction weight accounted for the smallest proportion. At present, the leisure and entertainment projects in forest health services mainly tend to young groups, which are less attractive to elderly consumers. Excessive entertainment and commercial facilities construction do not meet the initial needs of consumers to choose health bases. Therefore, in the face of the special consumer group of the elderly, it is very important to grasp the output content of the traditional service project of leisure and entertainment. We should pay attention to increasing the convalescent factors of the leisure and entertainment service plate to improve the attention of this level.

(3) At present, the evaluation of forest health satisfaction of the elderly population in the three northeastern provinces is at a good level. The consumer perception satisfaction of nine indicators such as basic accommodation services and public service facilities in the secondary indicators is higher than the evaluation emphasis, which belongs to the ' advantage maintenance ' index, and its index is the ' continuous reform ' index. Therefore, in the process of forest health development should focus on reform, for the ' advantage to maintain ' class indicators can slow the pace of development, and pay attention to excessive construction, long-term idle projects should be banned to prevent waste of resources ; for the indicators of ' continuous reform ', we should accelerate the development, effectively meet consumer demand, and ensure consumer experience to improve consumer satisfaction so as to promote the further development of forest health industry.

5.3 Suggestion

(1) It should highlight the style of forest health industry in its own region and strengthen cooperation and policy guidance. The overall forest resources of the three eastern provinces are superior. However, focusing on the three provincial capital cities, there are some differences in the level of GDP, residents ' consumption level, urban style and many other aspects. It is very important to quickly identify the development style of forest health industry suitable for its own region, and at the same time to achieve multi-faceted fit. In the face of the huge pressure of consumer demand in the current aging population market, it is necessary to ' seek common ground while reserving differences ' to strengthen mutual cooperation between urban areas, while the government and relevant departments should give overall consideration to common guidance.

(2) Guided by consumer demand, we should grasp the development direction of forest health and maintenance industry at the present stage, and promote the superior coupling between supply side and demand side. Consumer perceived quality and perceived value affect consumer satisfaction and loyalty . A large consumer group has a complex demand network. When exporting service supply, forest health industry should be guided by the demand network of consumer groups, combine industrial culture with demand orientation, and improve consumers ' perceived quality and value. Excessive supply output not only brings imbalance between supply and demand, but also reduces consumer loyalty. For the special consumer group of the elderly, it is a necessary condition be well grasped and the elderly can accurately perceive the service experience is a necessary condition to achieve the superior coupling between supply and demand.

(3) Combined with the essential demand of ' food, clothing, shelter and transportation ', we continue to excavate and supplement the connotation and form of service supply of forest health and maintenance industry in the elderly consumer groups, so as to achieve the balance of different demand levels. Consumers at different age levels have special needs and preferences. Based on the superior resource advantages of the three eastern provinces, health service practitioners should timely and effectively connect with market consumers and adjust the connotation and form of the supply side. To balance the supply to the age level, we can explore suitable services and products for the elderly on the basis of existing industries combined with the essential needs of ' food, clothing, shelter and transportation '.

(4) Enrich the promotion form of forest health industry, effectively improve the awareness and demand of the elderly consumer groups. At present, China 's aging population is deepening, the aging market is a huge potential consumer. However, at present, the awareness of the domestic elderly population on forest health industry is generally low. Therefore, it is necessary to adopt a multi-type and multi-channel promotion method and promote it accurately for the population, which can effectively improve the industrial awareness of the elderly consumer groups on the forest health industry and thus generate consumer demand.

(5) Facing the seasonal climate disadvantage in the development of forest health industry in Northeast China, it is necessary to make effective and accurate breakthroughs to bring about flexible and rapid development of the industry. Although Northeast China is rich in forest resources, it is located at a higher latitude in China, and the temperature is relatively low in autumn and winter, which has brought great obstacles to the development of forest health. Faced with this seasonal disadvantage, actively adjust the business strategy, focusing on summer forest health, is a development strategy that can accurately break the reality of seasonal factors, to help the rapid development of industry flexibility.

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