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Research Article

Research on High-Satisfaction Evaluation of Health-Care Product Design Based on Genetic Optimization Algorithm

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This paper proposes a high-satisfaction evaluation method for health-care product design based on the genetic optimization algorithm in order to deeply understand consumers' satisfaction with forest health-care products. This article builds a consumer demand index system for the service content of forest health-care bases from the four levels of environmental conditions, service items, supporting facilities, and service levels. According to the questionnaire survey results of 1000 randomly selected forest health-care consumers, based on the genetic optimization algorithm, the overall design takes the four levels of satisfaction evaluation into account, resulting in a more reasonable evaluation of health-care products. Experiments show that the method proposed in this paper outperforms the traditional method for evaluating health-care products.

1. Introduction

In recent years, urbanization has advanced, making the modern urban environment noisier, polluting the environment more intensely, and hastening the pace of life, all of which have combined to become a significant factor influencing the health of those who live there. Since the implementation of the Healthy China policy, the large health business has expanded rapidly, and forest health care has emerged as a necessity. Forest health care, which is based on forest resources, is a new type of emerging integrated development of the forestry and health industries [1–6]. Forest health care is an important component of the large-scale health project because it provides a safe environment for the treatment and rehabilitation of people who are ill or suffering from various diseases, and it is a supplement to the traditional medical service system. The state is currently actively promoting departmental linking in order to encourage the rapid development of the forest health-care industry in a coordinated manner. Key government departments have also made pertinent recommendations for its development on numerous occasions, including systematic policy support, stringent base building criteria, professionalization, and team of talent. The forest health-care business has a large development area and promising market opportunities, and it will become a new driving force for the national economy's development in the future [7–12].

In the forest health-care business unit, they develop distinctive health-care products and provide services such as recreation, fitness, elderly care, and recuperation in forest parks, nature reserves, and other environments that are conducive to people's health and wellness, such as forest parks, nature reserves, and other environments. The initial stages of growth of the sector were mostly concentrated in the provinces of Hunan and Sichuan. In 2015, Hunan Province began construction on the first batch of ten forest health-care bases, and other provinces such as Sichuan, Guizhou, and Fujian began the process of selecting and building provincial forest health-care bases. China announced the list of the first batch of national forest health-care bases in June 2020, which included 17 county-based national forest health-care bases such as Wuyuan County in Jiangxi Province, Taishan Yu Hot Spring Forest Health-Care Base in Heilongjiang Province, and Yichun City in Heilongjiang Province, among other places. There are 79 national forest health-care bases, each of which is organized into management organizations [13–20].

In recent years, the number of pilot units of forest health-care bases at all levels in my nation has continued to grow, but as an emerging business, it faces a number of challenges in its development, including a lack of widespread awareness and acknowledgment of the work done by these units. The majority of the public's understanding of the forest health-care sector is limited to forest tourism, and the description of the industry's foundation is somewhat ambiguous. Furthermore, the overall quality of the items and services is bad. In certain areas, the base construction is mechanically reproduced and given a bogus name, as is common in the United States. The items are all the same and have no distinguishing characteristics, which is out of touch with the diverse and unique needs of customers. Consumers are seeing an increase in the urgency with which they require a health-care environment and health-care services at this point [21–23]. Given the existing state of forest health-care bases, which provide insufficient service content and have the inadequate supporting infrastructure, it is vital to dig deeper into the needs of consumers. The purpose of this sort of demand hierarchy is to exactly fulfill the needs of consumers as well as to encourage and improve the creation of forest health-care bases as they are developed [24–30].

It was the 1840s, and the forest health-care industry was in its infancy. In response to the findings, German scientists developed the Kneipp therapy and built the world's first forest health-care base in the small town of Baden Willis Herne, located in Bavaria's southern plateau. For over 80 years, forest therapy has progressed through stages of discovery, development, improvement, and integration with other therapies. It has since been expanded in Sweden, the United Kingdom, the United States, Japan, South Korea, and several other countries. The forest environment and the effects of forest activities on human health are being studied, including efficacy, forest ecological service function, social welfare effect, forest leisure, green fitness, and mountain forest healing. Since 2012, a large number of domestic scholars have focused on forest health-care concept connotation, industrial development characteristics, development history, development of forest health-care bases, development of the forest health-care industry in state-owned forest areas, residents' forest health-care consumption needs and willingness to receive health care, and a variety of other issues [31–34] in order to do a related study. The forest health-care sector has seen rapid growth in recent years, but there have been few studies looking at the industry's development from the standpoint of industrial integration. The research objects of this study are China's forest health-care base and forest health-care industry. The methods used to analyze the development status and existing problems of the forest health-care industry are literature analysis, statistical analysis, and inductive analysis. The study also investigates the impact of industrial integration and industrial structure upgrading on the development of the forest health-care industry. The paper examines the consequences of the development of the forest health-care industry and makes recommendations for promoting the integrated development of the forest health-care industry. Its goal is to serve as a model for the development of a forest health-care product system based on industrial integration and the promotion of the long-term viability of the forest health-care sector [35, 36].

This paper investigates forest health-care consumers as the research object in order to classify and prioritize their needs, distinguish the strength of consumer demand for various elements in the services provided by forest health-care bases, and improve the efficiency and effectiveness of the services provided by the bases. The service will benefit consumers because it is more responsive to their needs.

2. Current Situation and Problems of Forest Health-Care Industry

2.1. Current Situation. As of 2012, China's forest health-care business has grown at a rapid pace, and several regions have begun to create forest health-care centers and health-care bases that are tailored to the specific needs of their respective resource bases. The China Forestry Industry Federation began organizing the application process for the pilot selection of forest health-care bases in 2015. The application process began in 2015. By the end of 2020, a total of six batches of pilot list announcements would have been made. After several years of pilot construction and operation, the four departments of the National Forestry and Grassland Development and Reform Department, the Ministry of Civil Affairs Department of Aged Services, the National Health Commission's Department of Aging Health, and the International Cooperation Department of the State Administration of Traditional Chinese Medicine passed the review on March 16, 2020. The review was conducted by the State Administration of Traditional Chinese Medicine and the National Forestry and Grassland Development and Reform Department. It was formally determined that a total of 96 national forest health-care bases would be established in the first batch, demonstrating the government's support and acknowledgment of the development of the forest health-care business on a national scale [37].

In spite of the fact that the Forest Health-Care Industry in China started rather late, the total number of forest health-care pilot building units in China has continued to increase. One thousand nine hundred and ninety-nine forest health-care base pilot units are expected to be finished and developed by the end of 2020. In total, 22 provinces, three municipalities directly under the Central Government, and five autonomous regions are home to forest health-care pilot bases, with the distribution being uneven across the country. Provinces and regions with a high concentration of forest health-care bases are also placed with a high concentration of forest resources. Several national forests and state-owned forest farms serve as the foundation for the majority of forest health-care establishments in the United States. Hubei Province has a total of 100 forest health-care base building units, making it the first province in China to achieve this feat. In Henan, Yunnan, and Shanxi, there are more than 80 of them. In Fujian and Sichuan, there are more than 60 of them. In Hunan, Guizhou, and Guangdong, there are more than 50 of them. In the remaining provinces, municipalities, and autonomous entities, there are less than 50 such people. It is difficult to find units applying for the pilot project of forest health-care industry construction in places like Qinghai, Ningxia, Xinjiang, Tibet, Gansu, and other provinces in China. According to the ranking of the number of construction units of forest health-care bases, more forest health-care bases are being built in provinces or regions with abundant forest resources, and fewer forest health-care bases are being built in regions with remote geographical locations and poor climatic conditions.

For the forest health-care industry to thrive, it must have favorable climatic conditions, such as a beautiful forest environment, forest greenness, forest color, negative oxygen ions, phytoncide, plant volatiles, plant essential oils, aromatic plants, and a favorable forest meteorological environment (humidity, temperature, wind speed, and forest therapy factors such as light and ultraviolet rays). If the forest health-care base is located in a favorable climatic environment, it can thrive. Hubei, Henan, Yunnan, Shanxi, Fujian, Sichuan, Hunan, Guizhou, and Guangdong are the provinces with the highest number of declared forest health-care bases, followed by Yunnan and Yunnan. The climate conditions in these provinces are more conducive to forest health-care activities than in the rest of the country. The northeast and northwest regions, which have extended low-temperature intervals, are more ideal for forest health-care operations for short periods of time. However, there are fewer forest health-care bases in these regions. A diverse development tendency can be observed in the practice of establishing the forest health-care sector in various locations as demonstrated by the development model of forest health-care base construction units. Examining the various domestic forest health-care bases, some are being developed on the basis of government reforms such as the transformation of state-owned forests and the reform of forest industry enterprises, while others are being developed on the basis of national forest parks, forest tourist attractions, wetland parks, and other natural resources. Based on comparisons between my country's forest health-care bases and other countries, it has been discovered that the types of forest health-care bases most commonly include tourism (tourism real estate), tourism homestays (tourism homestays), sightseeing (sightseeing), pension industry (forest industry transformation), nature reserves, and national-level provincial forest parks.

2.2. Problems. The majority of forest health-care bases are still in the early stages of development, with a focus on tourism. According to the current construction of domestic forest health-care bases, local construction enthusiasm is high, and the development model demonstrates a trend toward diversification and diversification of activities. The majority of forest health-care bases are established on the grounds of state-owned forest farms, forest parks, and tourist destinations; however, based on the current state of development of forest health-care bases, the majority of them continue to operate under the forest tourism business model. Despite the fact that it is a new industry based on forest tourism, the forest health-care industry is distinct from that of forest tourism. It is necessary to not only develop infrastructure but also to establish health-care courses and activities for citizens. It necessitates a lengthy development stage before it can be used in practice. Continue your exploration to identify a development model that is appropriate for each location. If forest health care cannot be industrialized or commercialized, it will remain in a theoretical state; if there is no breakthrough in forest health care itself, public opinion and social enthusiasm will gradually wane and forest health care will be forgotten; in order to avoid the occurrence of such problems, it is necessary to establish value standards and explore successful models.

Lack of progress has been made in the development of a suitable forest health-care product system. A large proportion of the existing forest health-care bases has been developed and proven profitable through traditional projects, whereas the service industry directly related to the forest health-care industry has not been developed, nor has the development and utilization of the forest health-care product system been proven profitable. Also, in some cases, the experience that the forest health-care business can provide users is limited due to a lack of resources. It is certain that the concept of forest health care will fade away with the passage of time and the diminishing level of public awareness if a good industrial model and production system cannot be developed. Forest health-care bases in China must continue to develop targeted forest health-care products and services during the construction process in order to be market-ready, form an effective industrial chain, and encourage the healthy and sustainable development of the forest health-care industry.

There is a scarcity of professionals with expertise in forest health care. Forest health care is a new, complete industry that has risen to meet the demands of the modern world. The establishment of appropriate forest health-care courses and matching health-care activities for diverse health-care groups is more critical at this stage in the process of development. The teaching of specific forest health-care courses, as well as the supervision of health-care activities, will be carried out by competent health-care professionals. The operation process of most forest health-care bases indicates that there is a shortage of professional health-care talents, which is preventing them from meeting the extensive health-care requirements of the health-care groups and the construction requirements of forest health-care bases.

Based on forest resources, the forest health-care industry expands the industrial chain that began with forestry, expanding to include tourism, medical and health care, education and training, health and leisure, and elderly care, opening up the boundaries of various industries and integrating and developing into emerging industries framework, and to encourage the development of modern forestry and forestry transformation as well as their transformation. Initially, it is industrial integration; however, the internal attribute is to increase the benefits that forestry, forest farmers, and forest areas receive as a result of the extension of the industrial chain and the upgrading of the value chain and finally realize the upgrading of the industrial structure, which will promote the development of forest areas and rural revitalization in the process. It refers to the integration of the forest health-care industry in its broadest sense. Product development is extremely significant in the forest health-care sector due to the high level of complexity that exists in the industry. To set up a reasonable forest health-care product system, it is necessary to combine high-quality forest resources with varying characteristics in various locations and to design and develop the forest health-care product system in accordance with the forest resource endowment—forest health-care product system design and development. In addition to assisting with concept design and development planning, supporting policies also help to foster the development of the forest health-care industry.

The development of the forest health-care industry is dependent on the availability of natural resources—forestry is the foundation for the development of the forest health-care industry, and forests are the primary location for the development of the forest health-care industry. In order to achieve people's physiological relaxation, improve mood, reduce stress, and improve human immunity and other functions, the forest ecological environment resources such as negative oxygen ions and phytoncide in the forest act on the human senses such as vision, smell, hearing, touch, taste, and other sensory factors, regulating the human body's psychology and physiology. Because of this, the quality of health-care resources available in the forest is an important component in the growth of the forest health-care industry.

3. Evaluation Model

It is proposed that, in order to build a scientific and reasonable consumer demand index system for forest health-care base services that is consistent with the model, this paper first selects forest health-care base service indicators based on the theoretical framework and research methods, combined with interview information from experts and forest health-care consumers, and then determines the indicator system and compass for forest health-care consumers.

This paper is based on the theoretical foundation and literature data that have been studied in this paper, as well as understanding the current status of the service content of forest health-care bases that have been conducted through group discussions, combined with information obtained on July 15, 2019, from forest health-care consumers and the State Forestry and Grassland Administration. The promulgation base basic data sheet initially produced a consumer demand index system for the service content of the forest health-care base based on expert opinions and pre-investigation results, but it was later changed as a result of the findings. Finally, consumer demand indicators for the forest health-care base's service content are divided into four levels: environmental conditions, service items, supporting facilities, and service levels. Under the four primary indicators, a total of 21 secondary indicators are established, which are as follows: consumer demand indexes for forest health-care foundation services are used in this system.

According to environmental conditions, the natural conditions of the base, such as meteorological conditions, air quality, sanitation, and other factors, largely determine the base's environmental circumstances. As a result, four indicators are chosen at this level: forest cover, light, yearly average temperature, and environment, with the latter including environmental indicators such as air quality and hygiene.

The things given by base are most visible in the areas of entertainment, health care, health-care-related services, education, sports, and other activities. As a result, at this level, the areas of leisure and entertainment, culture and art, health care, medical rehabilitation, and outdoor sports are chosen. There are classes, parent-child education, and aerobic exercise options available. There are seven indicators in total. For example, the leisure and entertainment sector is in charge of providing services such as recreational sports, leisure sightseeing, and other activities such as forest camping, forest picking, forest fishing, cultural events, and performances, among others. Services in the areas of artistic edification and cultural experience are provided for the cultural and artistic category. Forest Zen Rehabilitation, forest tea ceremony, forest art creation, custom, and cultural experience, as well as public outreach to educate people about the history and culture of forests, are among the services provided. Forest hot springs, forest baths, and forest nutrition, among other things, are examples of health-care services for both the mind and the body. In the context of medical rehabilitation and treatment, medical and health-care services such as forest psychological counseling, forest medicated food, aromatherapy, and medical exercise rehabilitation are all provided. Outdoor sports, such as forest mountaineering, forest exploration, wild hunting, forest rafting, and forest rock climbing, are intended to provide high-intensity sports services. Parent-child education is organized as follows to provide parent-child experience and forest education services, which may include forest scientific education, parent-child entertainment activities, and academic research activities: Aerobic exercise is intended to provide services for relaxing exercises such as forest cycling, yoga, Tai Chi, forest aerobics, health-care trail walking, and other similar activities.

Specifically, it is expressed at the level of supporting facilities primarily through the base infrastructure and associated supporting facilities for forest health care. Consequently, at this level, we have chosen to give catering and lodging, parking services, gift stores, and supermarket services, such as forest health-care items, as well as sightseeing cars and cable cars, among other things. Forest fire prevention is part of the security infrastructure, and a comprehensive forest health and wellness index monitoring system with six indications is also part of the system. The forest fire prevention infrastructure, for example, is composed primarily of three primary components: the forest fire risk monitoring and early warning system, the forest fire prevention command center, and the fire barrier system. Positive ions in the atmosphere, oxygen concentration and carbon dioxide detection techniques, and integral sound level meters are all components of a comprehensive monitoring system for forest health and well-being indicators.

When it comes to the level of service, it is mostly represented in the attitude of the base employees toward their customers and the professionalism of medical services. As a result, at this level, employees are chosen for their ability to maintain a courteous and cordial demeanor with customers. All of the staff members have obtained professional training and have strong professional abilities, including offering professional medical teams, guaranteeing diverse services, and employing specialists to manage and maintain forest resources, among the other four characteristics listed above.

First, determine the target variable relationship function and its parameters. According to formulas (1) to (5), the dependent variables are the satisfaction with forest health care, the satisfaction with environmental circumstances, the satisfaction with service items, the satisfaction with supporting facilities, and the satisfaction with the level of service. Indicators such as the ones listed above are relational functions of independent variables.

$$Y_1 = b_0 + b_1x_1 + b_2x_2 + \cdots + b_px_p, \tag{1}$$

$$Y_2 = b_0 + b_1x_1 + b_2x_2 + \cdots + b_px_p, \tag{2}$$

$$Y_3 = b_0 + b_1x_1 + b_2x_2 + \cdots + b_px_p, \tag{3}$$

$$Y_4 = b_0 + b_1x_1 + b_2x_2 + \cdots + b_px_p, \tag{4}$$

$$Y_5 = b_0 + b_1x_1 + b_2x_2 + \cdots + b_px_p, \tag{5}$$

where b_i is the coefficient, Y_i is the indicator, and x_i is factor that affects health. Forest health-care satisfaction levels range from Y_1 to Y_5 and include the contentment with environmental circumstances, the satisfaction with service items, the satisfaction with supporting facilities, and satisfaction with the overall level of service.

Construct a multiobjective optimization function model based on the genetic optimization method using the genetic optimization algorithm. The objective function that has been established is as follows:

$$\max\lfloor f_1(x), f_2(x), f_3(x), f_4(x), f_5(x)\rceil. \tag{6}$$

The constraints are as follows:

$$s.t. = \text{lower}_B \leq x \leq \text{upper}_B, \tag{7}$$

where lower_B denotes lower bound and upper_B denotes upper bound.

This is followed by the optimization function model's solution. In this work, the NSGA-II genetic algorithm is used to solve the optimization function model, which is implemented using MATLAB programming. The stages involved in solving a problem using this algorithm are as follows: to begin, develop real number coding for the decision variables in the model construction process, which may include leisure and entertainment, culture and art, health care, medical rehabilitation, outdoor sports, parent-child education, and aerobic exercise. The model contains a total of 21 indicators. Second, a random sample of N individuals is used to create an initial population, then nondominated sorting is performed, and the F_1 subgroup is obtained by selection, crossover, and mutation to produce the final product. Then, F_2 begins to combine the parent and child populations for quick nondominated sorting and crowding degree calculation and then selects suitable individuals to build a new parent population from the combined parent and child populations. Once this is completed, the basic operations of a genetic algorithm are employed to build a new generation of subgroups that are repeated indefinitely until the conditions are met. The fitness function has not changed much in this article, which is consistent with references 5 and 13.

The flow chart of the model is shown in Figure 1.

Specifically, the ideal Pareto solution set is evaluated by combining the complete assessment method of direct rights with the actual needs of solving the problem, and the following are the specific steps:

(1) The following formula can be used to represent a set of m evaluation schemes, n evaluation indicators, and the original data matrix of each indicator:

$$\begin{aligned} R &= \{r_{ij}\}_{m\times n}, \\ i &= 1, 2, 3, \cdots, m, \\ j &= 1, 2, 3, \cdots, n. \end{aligned} \tag{8}$$

(2) Calculate the standardized data using formula (9) and the standardized data matrix P using formula (7) and then determine the standardized data matrix P.

$$P_{ij} = \frac{r_{ij}}{\sum_{i=1}^{m} r_{ij}}, \tag{9}$$

$$\begin{aligned} P &= \{P_{ij}\}_{m\times n}, \\ i &= 1, 2, 3, \cdots, m, \\ j &= 1, 2, 3, \cdots, n. \end{aligned} \tag{10}$$

(3) Calculate the evaluation information entropy.

$$e_j = -\frac{\sum_{i=1}^{m} p_{ij} \cdot \log\, p_{ij}}{\ln(m)}. \tag{11}$$

(4) Calculate weights.

$$w_j = \frac{1 - e_j}{n - \sum_{j=1}^{n} e_j}. \tag{12}$$

(5) Calculate the value coefficient value b_{ij} similar to the normalization process.

$$\begin{aligned} b_{ij} &= \frac{r_{ij} - \min\{r_{ij}\}}{\max\{r_{ij}\} - \min\{r_{ij}\}}, \\ b_{ij} &= \frac{\max\{r_{ij}\} - r_{ij}}{\max\{r_{ij}\} - \min\{r_{ij}\}}. \end{aligned} \tag{13}$$

(6) Comprehensive evaluation of the Pareto solution set scheme, the calculation is shown in the following formula:

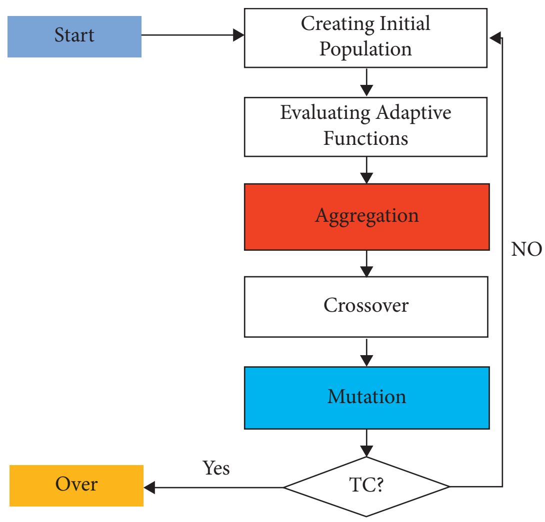

FIGURE 1: Flow chart of our method.

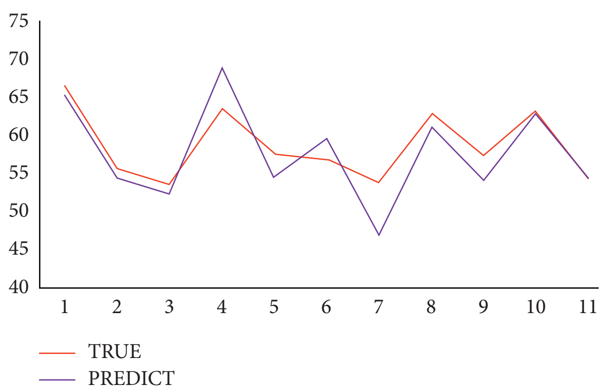

FIGURE 2: Model predicted values on environmental condition requirements.

$$CI_i = \sum_{j=1}^{n} w_j \times b_{ij}. \quad (14)$$

4. Results

First and foremost, this article assesses the level of satisfaction with forest health indicators using data collected from 1,000 customers on forest health-related metrics. In addition, the genetic optimization approach is used to train the satisfaction model, which is then compared to the actual calculated satisfaction. As an example, this article selects eleven forest health-care centers in Guangdong Province at random as samples, and the results of the high-satisfaction assessment model for health-care product design based on genetic optimization algorithm are shown in Figures 2 and 3.

According to Figures 2 and 3 of this study, using the method provided in this paper, it is possible to forecast consumer satisfaction with forest health-care items more accurately, with the relative error between the simulation value and the experimental value being less than 10%.

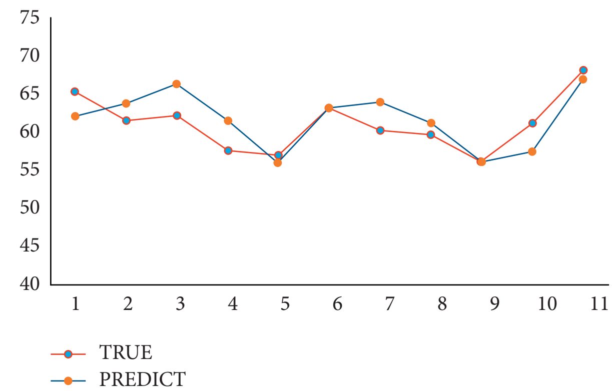

FIGURE 3: Model predicted values on service project requirements.

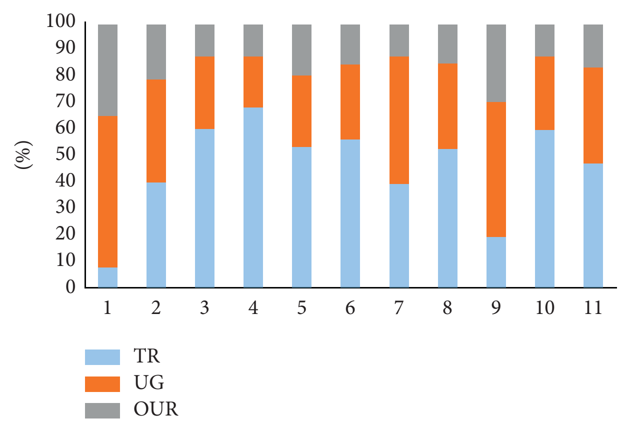

FIGURE 4: Model comparison on total satisfaction.

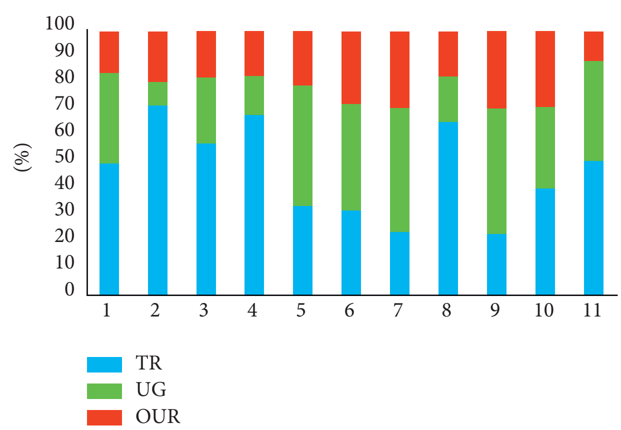

FIGURE 5: Model comparison on ancillary facilities demand.

In addition, the method proposed in this paper is compared to the traditional regression (TR) model and the unoptimized genetic model (UG). The total satisfaction index, the demand for supporting facilities, and the service level demand index are the comparison indicatorsFigures 4–6 depict the comparison chart. The comparison index is the absolute value of the estimation error.

The high-satisfaction evaluation method for health-care product design presented in this paper outperforms both the

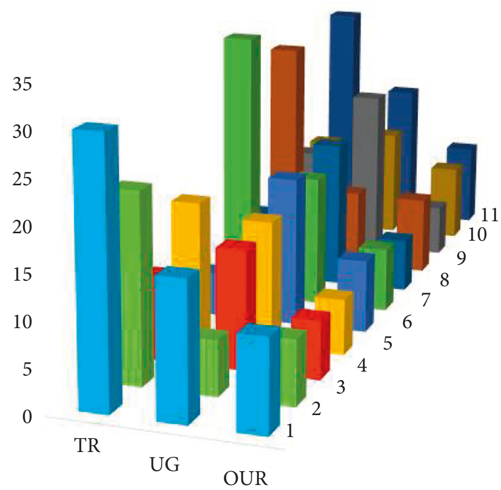

Figure 6: Model comparison on service level demand.

traditional regression method and the unoptimized genetic algorithm, and it can accurately assess the quality of forest health-care products as demonstrated by a comparative analysis of the various indicators used. Customer satisfaction is critical.

5. Conclusion

In order to gain a more in-depth understanding of consumers' contentment with forest health-care products, it is proposed in this study that a high-satisfaction evaluation approach for forest health-care product design based on genetic optimization algorithm be used. This paper proposes developing and implementing a consumer demand index system for the service content of forest health-care bases based on the four levels of environmental conditions, service items, supporting facilities, and service levels. The overall design takes into account the four levels of satisfaction evaluation in order to obtain a more reasonable evaluation of health-care products, which was achieved through the use of the genetic optimization algorithm, based on the results of a questionnaire survey of 1000 forest health-care consumers who were randomly selected. Experiments show that the method described in this study outperforms the standard method for evaluating health-care products as demonstrated in the paper.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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References

[1] H. Zhang and Y. Cui, "A model combining a Bayesian network with a modified genetic algorithm for green supplier selection," *SIMULATION*, vol. 95, no. 12, pp. 1165–1183, 2019.

[2] C.-C. Lin, J.-R. Kang, D.-J. Chiang, and C.-L. Chen, "Nurse scheduling with joint normalized shift and day-off preference satisfaction using a genetic algorithm with immigrant scheme," *International Journal of Distributed Sensor Networks*, vol. 11, no. 7, Article ID 595419, 2015.

[3] A. Apornak, S. Raissi, A. Keramati, and K. Khalili-Damghani, "Human resources optimization in hospital emergency using the genetic algorithm approach," *International Journal of Healthcare Management*, vol. 14, no. 4, pp. 1441–1448, 2021.

[4] T. Jan, P. Azami, S. Iranmanesh, O. Ameri Sianaki, and S. Hajiebrahimi, "Determining the optimal restricted driving zone using genetic algorithm in a smart city," *Sensors*, vol. 20, no. 8, p. 2276, 2020.

[5] S. Safdar, S. Ahmed Khan, A. Shaukat, and M. U. Akram, "Genetic algorithm based automatic out-patient experience management system (GAPEM) using RFIDs and sensors," *IEEE Access*, vol. 9, pp. 8961–8976, 2021.

[6] H. Park, D. Son, B Koo, and B. Jeong, "Waiting strategy for the vehicle routing problem with simultaneous pickup and delivery using genetic algorithm," *Expert Systems with Applications*, vol. 165, Article ID 113959, 2021.

[7] C. K. Y. Fung, C. K. Kwong, K. Y. Chan, and H. Jiang, "A guided search genetic algorithm using mined rules for optimal affective product design," *Engineering Optimization*, vol. 46, no. 8, pp. 1094–1108, 2014.

[8] Y. Shi, T. Boudouh, and O. Grunder, "A hybrid genetic algorithm for a home health care routing problem with time window and fuzzy demand," *Expert Systems with Applications*, vol. 72, pp. 160–176, 2017.

[9] T. Vidal, T. G. Crainic, M. Gendreau, N. Lahrichi, and W. Rei, "A hybrid genetic algorithm for multidepot and periodic vehicle routing problems," *Operations Research*, vol. 60, no. 3, pp. 611–624, 2012.

[10] A. Apoorva Gupta, M. Manoj Kumar, and S. Sushil Kumar, "A novel approach for market prediction using differential evolution and genetic algorithm," *Advances in Intelligent Systems and Computing*, Springer, in *Proceedings of the Fifth International Conference on Soft Computing for Problem Solving*, pp. 377–390, March 2016.

[11] J. Abdollahi and B. Nouri-Moghaddam, "Hybrid stacked ensemble combined with genetic algorithms for diabetes prediction," *Iran Journal of Computer Science*, vol. 3, pp. 1–16, 2022.

[12] S. Chernbumroong, S. Cang, and H. Yu, "Genetic algorithm-based classifiers fusion for multisensor activity recognition of elderly people," *IEEE journal of biomedical and health informatics*, vol. 19, no. 1, pp. 282–289, 2015.

[13] S. Setyaningsih and S. Sukono, "Analysis of factors affecting lecturer performance at a university during the COVID-19 pandemic using logistic regression and genetic algorithms," *Cypriot Journal of Educational Sciences*, vol. 17, no. 2, pp. 542–561, 2022.

[14] A. A. Taleizadeh, S. T. Akhavan Niaki, and V. Hoseini, "Optimizing the multi-product, multi-constraint, bi-objective newsboy problem with discount by a hybrid method of goal

programming and genetic algorithm," *Engineering Optimization*, vol. 41, no. 5, pp. 437–457, 2009.
[15] J. Luan, Z. Yao, F. Zhao, and X. Song, "A novel method to solve supplier selection problem: hybrid algorithm of genetic algorithm and ant colony optimization," *Mathematics and Computers in Simulation*, vol. 156, pp. 294–309, 2019.
[16] S. Asensio-Cuesta, J. A. Diego-Mas, L. Canós-Darós, and C. Andrés-Romano, "A genetic algorithm for the design of job rotation schedules considering ergonomic and competence criteria," *International Journal of Advanced Manufacturing Technology*, vol. 60, no. 9-12, pp. 1161–1174, 2012.
[17] Y. B. Park, J. S. Yoo, and H. S. Park, "A genetic algorithm for the vendor-managed inventory routing problem with lost sales," *Expert Systems with Applications*, vol. 53, pp. 149–159, 2016.
[18] Y. Yang, "Clustering and prediction analysis of the coordinated development of China's regional economy based on immune genetic algorithm," *Complexity*, vol. 2021, pp. 1–12, Article ID 5590631, 2021.
[19] Q. Li, J. Gong, R. Y. K. Fung, and J. Tang, "Multi-objective optimal cross-training configuration models for an assembly cell using non-dominated sorting genetic algorithm-II," *International Journal of Computer Integrated Manufacturing*, vol. 25, no. 11, pp. 981–995, 2012.
[20] T. Teranol and Y. Ishino, *Interactive Genetic Algorithm Based Feature Selection and its Application to Marketing Data analysis*, Springer, Boston, MA, pp. 393–406, 1998.
[21] R. Krishnamoorthi, S. Joshi, H. Z. Almarzouki et al., "A novel diabetes healthcare disease prediction framework using machine learning techniques," *Journal of Healthcare Engineering*, vol. 202210 pages, 2022, https://doi.org/10.1155/2022/1684017, Article ID 1684017.
[22] A. Beghi, L. Cecchinato, and M. Rampazzo, "A multi-phase genetic algorithm for the efficient management of multi-chiller systems," *Energy Conversion and Management*, vol. 52, no. 3, pp. 1650–1661, 2011.
[23] Y. Zhou, Y. Wang, K. Wang et al., "Hybrid genetic algorithm method for efficient and robust evaluation of remaining useful life of supercapacitors," *Applied Energy*, vol. 260, Article ID 114169, 2020.
[24] G. Kannan, A. Noorul Haq, and M. Devika, "Analysis of closed loop supply chain using genetic algorithm and particle swarm optimisation," *International Journal of Production Research*, vol. 47, no. 5, pp. 1175–1200, 2009.
[25] J. Xia, Y. Yan, and L. Ji, "Research on control strategy and policy optimal scheduling based on an improved genetic algorithm," *Neural Computing & Applications*, vol. 34, no. 12, pp. 9485–9497, 2021.
[26] X. Lü, Y. Wu, J. Lian et al., "Energy management of hybrid electric vehicles: a review of energy optimization of fuel cell hybrid power system based on genetic algorithm," *Energy Conversion and Management*, vol. 205, Article ID 112474, 2020.
[27] X. Gao and G. M. Lee, "Moment-based rental prediction for bicycle-sharing transportation systems using a hybrid genetic algorithm and machine learning," *Computers & Industrial Engineering*, vol. 128, pp. 60–69, 2019.
[28] C. Lin, K. L. Choy, G. T. S. Ho, and T. W. Ng, "A Genetic Algorithm-based optimization model for supporting green transportation operations," *Expert Systems with Applications*, vol. 41, no. 7, pp. 3284–3296, 2014.
[29] G. Du, X. Liang, and C. Sun, "Scheduling optimization of home health care service considering patients' priorities and time windows," *Sustainability*, vol. 9, no. 2, p. 253, 2017.
[30] H. Hassan and T. N. Tallman, "Failure prediction in self-sensing nanocomposites via genetic algorithm-enabled piezoresistive inversion," *Structural Health Monitoring*, vol. 19, no. 3, pp. 765–780, 2020.
[31] R. Hassanzadeh, E. Khorram, I. Mahdavi, and N. Mahdavi-Amiri, "A genetic algorithm for optimization problems with fuzzy relation constraints using max-product composition," *Applied Soft Computing*, vol. 11, no. 1, pp. 551–560, 2011.
[32] S. H. Zegordi, I. K. Abadi, and M. B. Nia, "A novel genetic algorithm for solving production and transportation scheduling in a two-stage supply chain," *Computers & Industrial Engineering*, vol. 58, no. 3, pp. 373–381, 2010.
[33] H. Chiroma, A. S. M. Noor, S Abdulkareem et al., "Neural networks optimization through genetic algorithm searches: a review," *Applied Mathematics & Information Sciences*, vol. 11, no. 6, pp. 1543–1564, 2017.
[34] J. Ghahremani-Nahr, H. Nozari, and M. Bathaee, "Robust box Approach for blood supply chain network design under uncertainty: hybrid moth-flame optimization and genetic algorithm," *International Journal of Innovation in Engineering*, vol. 1, no. 2, pp. 40–62, 2021.
[35] M. Sharma and S. Joshi, "Optimal media mix for iec campaigns using fuzzy linguistic genetic algorithm: a study of swachh bharat abhiyan (clean India mission)," *Journal of Operations and Strategic Planning*, vol. 2, no. 1, pp. 1–21, 2019.
[36] A. M. Brintrup, J. Ramsden, and A. Tiwari, "An interactive genetic algorithm-based framework for handling qualitative criteria in design optimization," *Computers in Industry*, vol. 58, no. 3, pp. 279–291, 2007.
[37] M. Li, "Research on the sustainable development strategy of forestry cultural heritage sites in henan province based on the analysis of big data," *Journal of Physics: Conference Series*, vol. 1744, no. 3, Article ID 032177, 2021.